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Data Center CAMPUS di Siziano
Siziano (PV)

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:
STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-AZ-XX-CA-M-55050

13038001

Title:
Calculation
PUE
Annual and Peak

PD0 - RIBA 3	**ITM**	**55050**	
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Phase 1 6 MW - Peak PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Number of DM	1	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
IT power consumed			
IT load	6000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	6000	kW	
Number of DM	1	[-]	
IT load per DM	6000	kW	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	20	kW	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	80	kW	
Total IT power	**6100**	**kW**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling	8	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	218	kW	Capacity 915 kW
Chiller pump consumption	20	kW	
Total chillers consumptions, pumps included	1906	kW	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	1	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	378	kW	
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	4	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	32	kW	
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	5	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	11	kW	
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	4	kW	
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	80	kW	
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	5	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	15	kW	
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	1	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	12	kW	
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	12	kW	
Other critical mechanical loads	30	kW	
Non critical mechanical loads	150	kW	
Total mechanical systems consumptions	**2630**	**kW**	
Electrical systems losses			
UPS losses	3,20%	[-]	
	230	kW	UPS for IT load (2*3*1000kW), mechanical pumps and air handling units for continous cooling (1*4*300kW)
IT distribution losses	1,00%	[-]	
	61	kW	
Mechanical distribution losses	1,00%	[-]	
	26	kW	
MV transformers losses	1,10%	[-]	
	100	kW	
Total electrical losses	**417**	**kW**	
Peak PUE calculation			
Total IT power	6100	kW	
Total power consumed	9148	kW	
Peak PUE	**1,500**		

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Phase 1 6 MW - Annual PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Number of DM	1	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
Calculation hours	8760	h	
IT power consumed (assumed static)			
IT load	6000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	52560000	kWh	
Number of DM	1	[-]	
IT load per DM	52560000	kWh	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	175200	kWh	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	700800	kWh	
Total IT power	**53436000**	**kWh**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling and glycol loop	8	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	456443	kWh	Capacity 915 kW
Chiller pump consumption	20	kW	Assumed static
Total chillers consumptions, pumps included	5053143	kWh	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	1	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	3311280	kWh	Assumed static
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	4	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	280320	kWh	Assumed static
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	5	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	96360	kWh	Assumed static
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	35040	kWh	Assumed static
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	700800	kWh	Assumed static
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	5	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	131400	kWh	Assumed static
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	1	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	105120	kWh	Assumed static
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	105120	kWh	Assumed static
Other critical mechanical loads	262800	kWh	Assumed static
Non critical mechanical loads	1314000	kWh	Assumed static
Total mechanical systems consumptions	**11395383**	**kWh**	
Electrical systems losses (assumed static)			
UPS losses	3,20%	[-]	
	2018304	kWh	UPS for IT load (2*3*1000kW), mechanical pumps and air handling units for continous cooling (1*4*300kW)
IT distribution losses	1,00%	[-]	
	534360	kWh	
Mechanical distribution losses	1,00%	[-]	
	113954	kWh	
MV transformers losses	1,10%	[-]	
	742478	kWh	
Total electrical losses	**3409096**	**kWh**	
Annual PUE calculation			
Total IT power	53436000	kWh	
Total power consumed	68240479	kWh	
Annual PUE	**1,277**		

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Phase 2 12 MW - Peak PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Number of DM	2	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
IT power consumed			
IT load	12000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	12000	kW	
Number of DM	2	[-]	
IT load per DM	6000	kW	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	20	kW	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	80	kW	
Total IT power	**12100**	**kW**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling	14	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	252	kW	Capacity 1045 kW
Chiller pump consumption	20	kW	
Total chillers consumptions, pumps included	3805	kW	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	2	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	756	kW	
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	7	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	56	kW	
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	8	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	18	kW	
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	4	kW	
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	80	kW	
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	8	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	24	kW	
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	2	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	24	kW	
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	12	kW	
Other critical mechanical loads	40	kW	
Non critical mechanical loads	150	kW	
Total mechanical systems consumptions	**4968**	**kW**	
Electrical systems losses			
UPS losses	3,20%	[-]	
	451	kW	UPS for IT load (2*6*1000kW), mechanical pumps and air handling units for continous cooling (1*7*300kW)
IT distribution losses	1,00%	[-]	
	121	kW	
Mechanical distribution losses	1,00%	[-]	
	50	kW	
MV transformers losses	1,10%	[-]	
	195	kW	
Total electrical losses	**816**	**kW**	
Peak PUE calculation			
Total IT power	12100	kW	
Total power consumed	17885	kW	
Peak PUE	**1,478**		

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Phase 2 12 MW - Annual PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Number of DM	2	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
Calculation hours	8760	h	
IT power consumed (assumed static)			
IT load	12000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	105120000	kWh	
Number of DM	2	[-]	
IT load per DM	52560000	kWh	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	175200	kWh	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	700800	kWh	
Total IT power	**105996000**	**kWh**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling and glycol loop	14	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	537622	kWh	Capacity 1045 kW
Chiller pump consumption	20	kW	Assumed static
Total chillers consumptions, pumps included	9979512	kWh	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	2	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	6622560	kWh	Assumed static
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	7	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	490560	kWh	Assumed static
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	8	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	154176	kWh	Assumed static
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	35040	kWh	Assumed static
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	700800	kWh	Assumed static
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	8	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	210240	kWh	Assumed static
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	2	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	210240	kWh	Assumed static
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	105120	kWh	Assumed static
Other critical mechanical loads	350400	kWh	Assumed static
Non critical mechanical loads	1314000	kWh	Assumed static
Total mechanical systems consumptions	**20172648**	**kWh**	
Electrical systems losses (assumed static)			
UPS losses	3,20%	[-]	
	3952512	kWh	UPS for IT load (2*6*1000kW), mechanical pumps and air handling units for continous cooling (1*7*300kW)
IT distribution losses	1,00%	[-]	
	1059960	kWh	
Mechanical distribution losses	1,00%	[-]	
	201726	kWh	
MV transformers losses	1,10%	[-]	
	1445211	kWh	
Total electrical losses	**6659410**	**kWh**	
Annual PUE calculation			
Total IT power	105996000	kWh	
Total power consumed	132828058	kWh	
Annual PUE	**1,253**		

MIL07

Via Lombardia 1, Siziano, MI, Italy

STACK INFRASTRUCTURE

Report - Statement of Requirements - Mechanical

MIL07-DBA-AZ-XX-RP-M-50002

07/11/2025

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1. INTRODUCTION

This report describes the requirements of the mechanical installations for the WS3 procurement phase of STACK MIL07 Data Center project. The DC has a total design IT power of 12 MW.

The critical mechanical installations consist of:

- Critical chilled water cooling system for DM and IT/EL rooms;
- DX critical cooling systems for IT/EL rooms;
- Critical ventilation systems for DM and IT/EL rooms;
- Fuel systems for generators;
- External pipework heat tracing system;
- Water leak detection system inside DM and IT/EL rooms;
- Fuel detection system;
- Glycol detection system for the chillers free cooling circuits;
- Mechanical smoke extraction systems.

The non-critical mechanical installations consist of:

- Non-critical VRF systems for office areas;
- Non-critical ventilation systems for office areas;
- Toilet exhaust ventilation systems.

The contractor shall ensure completeness of all supplies, accessories and all essential works and services required for a proper completion of the works.

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2. SCOPE OF WORKS

2.1. SCOPE OF WORKS DEMARCATION

The contractor shall review the design and accept responsibility for proper construction and coordination of the cooling, heating and fuel systems in accordance with relevant standards, codes and design parameters listed hereinafter.

The scope of works to be supplied and installed shall include:

- Compliance with all codes and standards applicable to this jurisdiction
- Shop drawings for equipment
- Coordination documents
- Record drawings
- All component selections
- Systems and components in accordance with specifications and drawings
- Tags and labels
- Work associated with delivery, storage, and handling of products
- Work associated with provision of temporary facilities
- Design and provision of supports and anchors
- Pipe portals
- Equipment rails
- Access panels and doors
- Identification markers
- Coordination of electrical requirements for equipment provided
- Proper cleaning and closing
- Start-up service, commissioning, testing and training
- Certification
- CE marking and certificates
- O & M manuals / IOM manuals (Installation, Operation & Maintenance manuals)
- Preparation of posted operating instructions
- Meeting project safety and indemnity requirements
- Supplying proper warranty information
- Supply specified guarantee documentation

2.1.1. OFCI equipments

The critical mechanical equipments considered as free client deliveries are:

- Chillers
- DM Fan Wall units
- HVAC equipments of the electrical pods (CRAHs, DX units, fans, leak detection…etc)
- Fuel pump of the gensets and other mechanical equiments installed inside the genset container

The scope of works and service is indicated in the OFCI documents.

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2.1.2. Generator containers mechanical systems scope of works demarcations

	General Contractor	Generator Supplier
Cooling and ventilation systems inside the containers		X
Flues emission control systems		X
Chimneys and hot air hoods		X
Sprinkler pipework from the building dedicated control valves till the containers	X	
Sprinkler pipework and sprinkler heads inside the containers		X
Sewage underground pipework for containers and chimneys drains	X	
Commissioning	X	X
Controls of cooling and ventilation systems		X
Cabling between containers control panels and BMS system	X	

2.1.3. Fuel and urea system scope of works demarcations

	General Contractor	Generator Supplier
Generator control panels (GCP)		X
Fuel and urea pump sets		X
Fuel undergound tanks	X	
Fuel filling for commissioning and final filling	X	
Fuel pipes from underground tanks to genset containers	X	
Fuel systems inside the genset containers, included all required valves and equipments (day tanks)		X
Safety fuel supply closing system, including closing valve		X
Urea systems, urea tanks and urea filling for commissioning and final filling		X
Fuel systems from filling stations till fuel tanks	X	
Commissioning	X	X
Leak detection double walled piping and tank	X	
Leak detection inside the generator container		X
Controls fuel tank filling	X	
Controls fuel and urea pumps		X
Cabling between containers control panels and BMS system	X	
Mobile fuel polishing unit	X	

2.1.4. Electrical pods mechanical systems scope of works demarcations

	General Contractor	Electrical Pod Supplier
Cooling and ventilation systems inside the pods		X
Cooling pipse till the container to supply chw from the building system to the container CRAHs	X	
CRAHs interception and flushing valves installed outside of the containers	X	
CRAHs strainers and other required pipe accessories installed inside the container		X
Leak detection inside the containers		X
Sewage underground pipework for containers drains	X	
Sprinkler pipework from the building dedicated control valves till the containers	X	
Sprinkler pipework and sprinkler heads inside the containers		X
Commissioning mechanical systems	X	X
Controls of cooling and ventilation systems		X
Cabling between containers control panels and BMS system	X	

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2.2. INSTALLATION PHASING STRATEGY

Critical systems and equipments will be installed in 2 phases, each phase is for 6 MW IT (1 DM for each phase). At full build-out the building will consist of 2 DM (6 MW each), for a total IT load of 12 MW.

The 2 critical phases are almost identical for mechanical installations, the only main difference is on the cooling generation where the redundancy is shared between the whole building, as described later.

The mechanical installations for the non-critical area (offices and storages), will be installed in phase 1.

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3. CONTRACTORS' OBLIGATIONS

3.1. CONSTRUCTION DESIGN OBLIGATIONS

In preparation of and during the execution of the project the contractor shall fulfil the following term and conditions:

- Construct Work to conform to the project construction schedule
- Order the progress of mechanical work to conform to the progress of other trades
- Order the progress of mechanical work to conform to the progress of other trades
- Coordinate the work specified in this division with all other project work
- Prior to fabrication or installation participate in detailed coordination planning meetings with all other building utilities systems trades, so as to completely establish routings, elevations, space requirements, and coordination of layout and suspension requirements in relationship to the building structure and the work of all other trades
- The Contract documents, including specifications and construction drawings, are intended to provide all material and labour to install complete cooling and heating, systems for the building
- Contract drawings indicate general arrangement of mechanical systems. Information shown is generally schematic except where otherwise shown or detailed, and field verification of all dimensions, locations, and levels is required. In preparing its cost proposal, Contractor shall make allowances for adjustments needed to conform to conditions arising from field conditions and the work of other trades; architectural drawings shall govern the final installation requirements. Any discrepancies between drawings and/or specifications shall be brought to the attention of the Architect/Engineer in writing prior to opening of bids; subsequently, determination of responsibility for adjustments shall be at the sole discretion of the Architect/Engineer
- The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract drawings and he shall coordinate his work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipelines and are not to be scaled; all dimensions and existing conditions shall be checked at the building
- Where exposed work or connections to Owner's fixtures or equipment is shown in schematic form, the Contractor shall review the proposed configuration of such work or connections with the Owner's authorised representative before proceeding and shall comply with the Owner's requirements
- Drawings and specifications are complementary to each other. Include any work, materials or equipment indicated on the drawings but not described by the specifications or described by the specifications but not shown on the drawings, which is necessary for the completion of mechanical systems
- Although such work may not be specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a complete mechanical system
- Prepare drawings showing proposed rearrangement of work to meet job conditions, including changes to work specified under other sections. Obtain permission of Architect/Engineer before proceeding
- The Contractor shall comply with the project closeout requirements

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3.2. GENERAL OBLIGATIONS

In general, the following preconditions are applicable for the project:

- Examine all existing conditions at building site
- Review contract documents and technical specifications for extent of new work to be provided
- Provide and pay for all permits, licenses, fees and inspections
- Prepare a Construction IAQ Management Plan
- Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access
- Verify final locations for rough ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications for rough-in requirements
- Coordinate mechanical equipment and materials installation with other building components
- Verify all dimensions by field measurements
- Arrange for chases, slots, and openings in other building components to allow for mechanical installations
- Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed
- Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give attention to large equipment requiring positioning prior to closing-in the building
- Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted
- Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible
- Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations
- Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations
- Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service
- All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less in addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified
- Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor
- Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this division. Any such products installed as part of the work of the division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor

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3.3. MINOR DEVIATIONS

The drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this section.

The Contractor shall review the structural and architectural conditions affecting his work. It is the specific intention of this section that the contractor's scope of work shall include:

- Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
- Minor deviations from the mechanical plans required by architectural and structural coordination

The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the “Electrical Work”. Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labour and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

Advise the Engineer, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Engineer of conflict.

3.4. PRODUCT SUBSTITUTIONS

When proposing alternative products:

- The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design
- Substituted product to be approved by the owner/engineer
- The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution
- The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements
- Maintenance and service parts available locally are readily obtainable for the proposed substitute
- The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item
- The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution

3.5. CODES AND REQUIREMENTS

Unless otherwise stated in these general and special conditions and in the work description, the following shall apply to quotations, assignment of work and execution:

- The Contractor shall ensure that the completed works fully comply with all applicable Italian / local Norms, Standards, Codes, Regulations and Statutory Regulations
- In addition, the Contractor shall fully comply with the requirements of all design / manufacture / installation and testing standards identified in the tender documents. Where no standard is

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given, the Contractor shall adopt the appropriate UNI standard or international (ISO, IEC etc.) or European (EN) standard as the default standard. Other specific Standard requirements are: ASHRAE Guidelines; CIBSE Guides; BESA Guides; applicable By-laws and other Regulations and local authority agreements or requirements
- Quality of work shall be in accordance with local standards and regulations
- The Contractor shall ensure that the design, materials and installation do not conflict with any instructions from the authorities. Failure to meet this requirement will be the Contractors responsibility to rectify at his cost
- Local conditions, Standards and Regulations only supersede this Specification where they demand a higher standard
- The Contractor shall ensure that all manufacturers used and all plant, equipment and ancillaries utilised for this project have been fully inspected, approved and certified by the local authority that has jurisdiction. Under no circumstances shall any items not so certified be used
- Design and fabrication of equipment, and all operations connected therewith, are subject to the approval, inspection, by-laws, and regulations of all local authorities and all organisations and other public services having jurisdiction
- The Contractor shall submit all drawings and other documents as necessary to apply for, and obtain, all such approvals
- All necessary applications for fabrication (and cost thereof) for approval shall be included in the Works. Any changes or alterations required by the authorised inspector of the authority having jurisdiction shall be made without charge
- The Contractor shall supply and install all warning signs and nameplates as required by the local building and labour inspection authorities
- The properties of equipment and the design, performance, characteristics, and methods of construction of all items shall be in accordance with the latest edition of applicable Codes

3.5.1. Standards, guidelines, specifications or regulations

In cases where two codes or standards conflict, the most stringent criteria shall govern, unless agreed otherwise by the Client.

Compliance with any requirements issued by regulatory bodies shall not decrease the quality of workmanship and material specified herein.

3.5.2. Seismic considerations

The building is located within seismic zone Class 3 with a maximum acceleration value of 0.73 m/s² at ground level per DECRETO 17/01/2018 (Strategic buildings class IV, ground category C-T1). All the equipment mountings shall be capable of withstanding additional dynamic loads that may be encountered as a result of this acceleration.

3.6. SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

Prior to construction the contractor shall submit for review details of all materials and equipment.

After approval of preliminary list of materials, the Contractor shall submit Shop Drawings (including native files) and manufacturer's Certified Drawings to the Client Representative for approval.

The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring power and controls connection, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate.

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Submittals and Shop Drawings shall be submitted in PDF format as a complete bound package. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Submit typed copies of submittals (number to be determined during construction).

RFIs and submittals are to be sent to via a digital document management platform of the Client preference:

- Include the project title and Submittal number in the e-mail subject line
- Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work

3.6.1. Request for information and submittals

Requests for Information:

- All RFIs are required to be in electronic format using a digital construction management system
- RFIs that are larger than 10MB should be reviewed for other possible means for electronic transfer – sharefile, SharePoint, FTP, etc
- Include the project title and RFI number in the e-mail subject line

Submittals:

- All submittals are required to be in electronic format using a digital construction management system
- Submittals that are larger than 10MB should be reviewed for other possible means for electronic transfer – sharefile, SharePoint, FTP, etc
- Include the project title and Submittal number in the e-mail subject line

3.6.2. Unit pricing submittals

Prior to construction submit for review all materials and equipment in accordance with this division of the specification.

Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to Owner for preliminary approval a complete list of manufacturer's names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review:

- Indicate substituted items
- Identify test and balancing agency

The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labour cost index.

Submittals and Shop Drawings shall be submitted in PDF format as a complete bound package. Submit six (6) typed copies of submittals.

3.6.3. Coordination documents

The Contractors shall prepare coordinated Shop Drawings to coordinate the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances. The Drawings shall include all mechanical rooms and floor plans. The Drawings shall be Overlay Drawings showing each discipline

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on a single sheet. The Drawings shall be keyed to the structural column identification system and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Architect and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide reasonable maintenance access requirements. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor, Architect, and Owner. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

The Drawings shall be prepared as follows:

- The Mechanical Contractor shall prepare Drawings to an accurate scale of 1:50 or larger, Drawings shall indicate location, size and elevation above finished floor, of all HVAC equipment, ductwork, and piping. Plans shall also indicate proposed ceiling grid and lighting layout, as shown on electrical plans and reflected ceiling plans
- The Plumbing Contractor shall obtain reproducible plans from the Mechanical Contractor, and indicate all plumbing lines including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor
- The Fire Protection Contractor shall obtain reproducible plans with the detailed mechanical and plumbing work shown. The Sprinkler Contractor shall indicate location of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor
- Plans are to incorporate all addenda items and change orders
- Distribute plans to all trades and provide additional coordination as needed

Advise the Engineer and Owner in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Engineer and Owner of conflict.

Provide means of access to all valves, dampers, controllers, operable devices, and other apparatus that may require adjustment or servicing.

Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Engineer and Owner of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

3.6.4. Drawings

Drawings indicate equipment capacities, tagging and labelling, sizes, locations, connections to equipment and methods of installation.

Before proceeding with work check and verify all dimensions.

Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

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If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect or Engineer for his interpretation and decision as early as possible, including during bidding period.

3.6.5. Shop drawings

Piping System:

Draw to a scale not less than 1:20, with sheet sizes equal to Contract Drawings.

Indicate layout of each piping system. Indicate piping system routing showing pipe sizes, elevations, critical dimensions, valve locations, and manhole locations. Indicate on shop drawings leak detection and locating system routing and panel location.

Indicate gradients of pipework, air vents and drain valves, show expansion provisions, including guides and anchors.

The contractor shall include on his shop drawings full details of all support systems and shall submit these to the Clients representative for approval. Anti-vibration supports shall be fitted at all locations where pipework vibration is likely to be a problem.

Ductworks and plenums:

Draw to a scale not less than 1:20, with sheet sizes equal to Contract Drawings.

Show duct sizes, where possible use even duct sizes.

Show fitting details and access hatches

Show coordination with lighting fixtures, fire dampers, smoke dampers, piping, diffusers, grilles, registers, fans, major electrical runs, cable trays and bus ducts.

Field erected mechanical equipment:

Draw to a scale of 1:20, with sheet sizes equal to Contract Drawings.

Show plan, sections, elevations and details of all joints and enclosures.

Detail access doors and hardware.

Detail coil, damper, humidifier, filter and fan installations.

Show access space for electrical components that are part of the equipment provided and/or installed such as power and control panels on humidifiers.

Air Handling Units:

Provide to a scale of 1:20 shop drawings for each air handling unit drawn to scale and showing each component of the unit. Include plan, elevation, and end view of air handling units.

3.6.6. Product data

Submit for each component Product Data including:

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- Manufacturer's technical product data
- Indicating data figures such as dimensions, flow, capacity, pressure setting, tolerances etc

Submit for each component Maintenance Data including:

- Maintenance instructions, including instructions for lubrication, valve replacement
- Spare parts lists
- Include this data, product data, and shop drawings in operating and maintenance manuals.

Piping:

- Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalogue information
- Valves: Submit manufacturer's catalogue information with valve data and ratings for each service
- Hangers and Supports: Submit manufacturer's catalogue information including load capacity
- Piping Specialties: Submit manufacturer's catalogue information including capacity, rough-in requirements, and service sizes
- Leak Detection and Location System: Submit manufacturer's catalogue information for controller, alarm unit, cable type, and pipe containment
- Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipes, and riser support hangers

Pumps:

- Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes
- Pumps: Manufacturer's Installation Instructions: Submit data for each type of pump
- Submit manufacturer's shop drawings indicating dimensions, weight (shipping, operating), required clearances, methods of assembly of components, and location and size of each field connection
- Manufacturer's Certificate: Certify Products meet or exceed specified requirements, especially to be rated for outdoor conditions down to -17.4°C (N=20)
- Manufacturer's Field Reports: Submit report of each visit of manufacturer's representative to provide technical assistance during installation
- Maintenance Data: Submit maintenance instructions, including instructions for lubrication, tube replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals
- Wiring Diagrams: Submit manufacturer's ladder-type wiring diagrams for power and control wiring required. Differentiate between factory-installed and field-installed wiring

Ventilation, submit for approval on all materials and equipment, including:

- Ductwork – rigid and flexible
- Ductwork specialties
- Flexible connections
- Sealants, adhesives and tapes
- Duct access panels and doors
- Backdraft dampers
- Control dampers
- Fire and fire-smoke dampers
- Diffusers, grilles, and registers
- Variable Air Volume (VAV) boxes
- Fan powered air terminal

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Air Handling Units:

- Submit product data for all materials and equipment in the AHU to demonstrate compliance with every requirement of the schedules and specifications. When product data is insufficient to demonstrate compliance, provide information type written on the manufacturer's letterhead. Provide separate fully approved 'Issued For' Construction product submittal data prior to commencing production of units unless receiving owner's authorization to proceed in writing prior to final approval of full product submittal data package.
- Product Data Submittal shall include:
    - Product data for all components and subsystems.
    - Provide total system pressure drop within the air handling unit based on the scheduled external static pressures and all internal pressure losses including: coils, dampers, louvers, filters, humidifiers, sound attenuators, systems effects, etc. The manufacturer shall submit total pressure drop calculations which shall be done at the full design flow of the air handling unit or component. Where provided include mixing box static pressure losses in internal static pressure.
    - Filter pressure drop allowance. The air handling unit manufacturer shall base filter pressure drops for fan sizing on the manufacturer's recommended change-out pressure drop. The manufacturer shall submit the filter data supporting their calculations.
    - Unit controls internal sequence and P&I D diagram
    - Control points list
    - Control system programming
    - Factory-certified performance ratings on the following:
    - Direct Evaporative media
    - Fan performance with curves showing specific scheduled operating point.
    - Full unit electrical diagram, including all connections, fuses, and powered components. Shall include separate diagrams for primary and control power systems.
    - Control system
    - Manufacturer's Installation instructions

3.6.7. Test reports

Submit written test results for piping system pressure test.

Manufacturer's Installation Instructions: Submit piping system, piping accessories and leak detection and location system data.

Manufacturer's Certificate:

- Certify Products meet or exceed specified requirements
- Submit certificate of evaluation of leak detection and location system by independent third party
- Manufacturer's Field Reports: Submit report of each visit of manufacturer's representative to provide technical assistance during installation
- Welders Certificates: Certify welders employed on the Work, verifying qualification within previous 12 months

3.6.8. Testing, Adjusting and balancing

Forms:

- The Contractor shall deliver a complete copy of standard forms for testing and balancing work associated with the project
- These forms shall serve as specific guidelines for producing final test report
- Hybrid or non-standards forms are not acceptable

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- Data shall include, but not be limited to, a title page with building information, instrument lists, air flows, water flows, temperatures, sound levels, capacities, nameplate data

Test Reports:

- Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work
- The final reports shall include identification and types of instruments used, and their most recent calibration date, and key plans identifying all inlets and outlets
- Final test reports shall be typed
- Handwritten reports are not acceptable

Maintenance Data:

- Include, in maintenance manuals, copies of certified test reports and identification of instruments

Qualifications:

- The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work and the name of the certifying engineer
- Provide a reference list of five (5) similar size projects with contact person and telephone number

3.6.9. Closeout submittals

Up to date As-Built Revit model at RIBA 6.

Project Record Documents: Record actual locations of valves, piping system, and system components.

Project Record Documents: Record actual locations of piping mains with invert elevations, valves, manholes, and leak detection and location system.

Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

3.7. EXECUTION

3.7.1. Qualifications

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Leak Detection Systems: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

3.7.2. Delivery, storage, and handling

General:

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- Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling
- Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping shall be stored in bundles covered with waterproof membrane. Piping showing signs of rust shall be removed from site and replaced
- Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations
- Comply with the manufacturer's rigging and installation instructions

Products:

- Accept valves on site in shipping containers with labelling in place. Inspect for damage
- Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation
- Accept pumps on site in shipping containers with labelling in place. Inspect for damage
- Accept OFCI equipment on site. Inspect for damage. Equipment to be transported and installed by the contractor per the supplier’s instructions.

3.7.3. Safety and indemnity

No act, service, Drawing, review, or Construction Review by the Owner, Architect, Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

3.7.4. Observation of the works

The Contractor shall provide opportunity for the Architect/Engineer, Code Enforcement Authorities and/or the Owner's representative to examine all work prior to concealment. This includes exterior piping and services prior to backfill of trenching, all interior roughing-in of piping, ductwork or equipment prior to insulating or other concealment. The Contractor shall notify the Architect/Engineer and/or the Owner's representative at least 72 hours in advance of such work so that the appropriate representative(s) may perform such observations prior to concealment. Notification of Code Enforcement authorities sufficiently in advance of concealing work is the Contractor's responsibility.

3.7.5. Temporary facilities

Provide temporary heating, air conditioning, ventilation, water, and sewer, etc. services as necessary during the construction period.

Temporary Heating for Commissioning Tests:

- Provide temporary heating where needed to provide false load for commissioning tests
- Temporary heating may be from the permanent heating system of the project or from a dedicated temporary heating system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon what work in place or being installed

Temporary Cooling for Commissioning Tests:

- Provide temporary cooling where needed to provide false load for commissioning tests

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- Temporary cooling may be from the permanent cooling system of the project or from a dedicated temporary cooling system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon the work in place or being installed

3.7.6. Environmental requirements

Materials / components and systems to be installed as per the supplier requirements.

3.7.7. Field measurements

Verify field measurements prior to fabrication.

3.8. FINAL OBSERVATION

At completion of the work, the Contractor shall notify the Architect/Engineer and request the final observation.

Prior to such request, all work under the contract shall be completed and all systems shall be in proper working order and placed in operation.

All air and water systems shall be properly balanced with quantities shown on the drawings, and all water circuits shall be adjusted to provide the proper flows.

All equipment shall be cleaned, including plumbing fixtures. All debris and construction materials shall be removed from the premises.

Control and instrumentation systems shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.

At the request of the Architect/Engineer, a representative of the Contractor who is thoroughly familiar with the project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested, the contractor shall have representatives from his subcontractors present to assist during final observation.

3.9. RECORD DRAWINGS

Before commencing installation, obtain an extra set of prints from the Engineer, marked “Record”. This set of drawings shall be kept at the construction site at all times and used for no other purpose but to mark on it all the changes and revisions to the Contract Drawings resulting from coordination with other trades. At the completion of the project:

- Edit project Revit files to incorporate all site mark-ups, changes, and revisions to the Contract Drawings. This shall be done as documented in the BIM requirements
- Provide copy of Record Drawings to Testing and Balancing Contractor for use when doing his work.
- Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices

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- Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used

3.10. START-UP SERVICE AND BUILDING COMMISSIONING

Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, pumps and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

Contractor shall be responsible for assisting Owner and 3rd party commissioning agent during testing and shall be responsible for resolving issues with equipment and workmanship discovered therein.

The Owner will contract separately for the services of an independent commissioning agent. The independent commissioning agent will perform testing of completed systems, including the following:

- Pre-functional tests
- Equipment level functional tests
- System level functional tests
- A final integrated system test

The Contractor shall cooperate with the independent commissioning agent, and coordinate construction activities with the independent commissioning agent. In addition, the contractor shall promptly correct any deficiencies noted by the independent commissioning agent.

The independent commissioning agent will conduct an integrated system test at the completion of construction activities. This test is being conducted to assure proper performance of all building systems when operated together. The contractor shall furnish coverage for the full duration of the integrated system test to assist in resolution of any issues uncovered during the test.

Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

Equipment manufacturer:

- The manufacturer shall provide start-up service in the form of a factory trained service technician
- The service technician shall verify correct installation, verify pump systems mounting, verify piping installation, verify control wiring, verify power wiring, and check for proper operation
- The service technician shall provide final adjustments to meet the specified performance requirements
- Fully staffed parts and service personnel shall be within four hours travel from the jobsite

3.11. INSTRUCTION, MAINTENANCE AND O&M MANUALS

O&M Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Owner complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder.

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Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed to be no less than two hours for each piece of equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

The O&M manuals and documentation to include (at least) the following:

- Description of the main design principles
- All calculations to be provided
- An asset register of plant and equipment (describing items of equipment, assets or elements of the work).
- Product information (specifications)
- Document maintenance schedules and tasks
- Spare parts list
- Instructions for its operation and maintenance (including health and safety information and manufacturers' instructions for efficient and proper operation) for all equipment, components and systems.
- Commissioning and testing results.
- A declaration of conformity to be provided
- Guarantees, warranties and certificates.
- Requirements for demolition, decommissioning and disposal
- As-built drawings and specifications
- Help and contact information

3.11.1. Posted operating instructions

Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

3.12. QUALITY ASSURANCE

If defects are discovered within the warranty period after acceptance by the client, the client will give notice of these defects. The notice of defects shall be deemed to have been given in due time if it is received by the Contractor before the expiry of the guarantee period. The Customer shall set the Contractor a deadline for the rectification of the defects. Should the defined defects not have been remedied by the Contractor within the time limit, the Client shall set the Contractor a second and final shorter deadline for remedying the defects. If the defects are still not remedied, the Client may have the defined defects remedied by third parties at the Contractor's expense.

The Contractor shall take all the points listed in this item into account accordingly when setting the price. Repeated specifications and requirements are only described in this chapter and not in the individual chapters of the bill of quantities.

Perform Work in accordance with code for installation of piping systems for welding materials and procedures or local standards and requirement.

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Perform Work in accordance with authority having jurisdiction and for welding hanger and support attachments to building structure.

Testing, adjusting and balancing:

- Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months
- Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer
- The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:
    - The various system installers, suppliers and contractors shall provide all required materials, labour and tools to make corrections when required without undue delay. Install balancing dampers as required by testing and balancing agency
    - The contractor shall put all heating, ventilating, air conditioning and fuel systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing
    - Testing and balancing agency shall be kept informed of any major changes made to the system during construction and shall be provided with a complete set of Record Drawings.
    - The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work
- General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met:
    - Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment
    - Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials
    - All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal states
    - All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions

Variable Frequency drives:

- Supplier of VFD shall be solely responsible for assuring that the VFD shall work properly with the motor(s) being controlled. VFD supplier shall provide all materials and labour required to replace motors, bearing, shafts, etc. that may be incompatible with VFD or become damaged by VFD at no additional cost to the owner. VFD supplier shall reimburse Architect and Engineer at their standard hourly rates for their involvement in resolving failures due to their VFDs
- Manufacturer shall have a minimum of 15 years' experience building similar equipment for controlling the speed for induction motors and at least one hundred successful installations with a variety of VFD sizes and applications
- To ensure quality and minimize failures the VFD(s) and connected motor(s) shall be by one manufacturer. To reduce the known problem of bearing failures by "fluting" the VFD switching

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rates shall be 6-8 Khz wherever possible. Manufactured VFDs at switching rates of 12-15 Khz shall be accompanied by an additional extended warranty to cover bearings and motors to a period of ten (10) years. Should it be impossible to provide matched motor and VFD's provide a shaft grounding system for the driven motor. Acceptable manufacturer is Shaft Grounding
- To ensure quality and minimize infantile failures at the job site, the VFD shall be burned in at the factory at an ambient of 40°C minimum for at least 8 hours. The VFD shall be operating a dynamometer and the load speed shall be cycled during the test. All optional and special features shall be functionally tested at the factory for proper operation.

3.13. WARRANTY

The warranty requirements in the project general terms and conditions are leading. If not mentioned the following warranty conditions should apply:

- All equipment shall be provided with a minimum one-year warranty to include parts and labour. Refer to individual Equipment Specifications for extended or longer-term warranty requirements
- Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services
- The warranty shall include parts, labour, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service
- Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period

Additional warranty requirements:

- Furnish five-year manufacturer warranty for Valves excluding packing
- Furnish five-year manufacturer warranty for leak detection and location system
- Furnish five-year manufacturer warranty for Pumps
- Furnish five-year manufacturer warranty for Tanks
- Furnish five-year manufacturer warranty for Compressors
- Furnish five-year manufacturer warranty for Heat Exchangers
- Furnish five-year manufacturer warranty for Control Boards
- Furnish five-year manufacturer warranty for Variable-Speed Fan Motors
- Furnish two-year manufacturer warranty for Variable-Speed Drives

3.14. GUARANTEE

The Guarantee requirements in the project general terms and conditions are leading. If not mentioned the following guarantee conditions should apply:

- The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year after the Date of Final Acceptance, ordinary wear and tear excepted
- Contractor shall be responsible for and pay for any damages caused by or resulting from defects in his work

3.15. LABELLING OF COMPONENTS

All mechanical components, including OFCI equipment have been coded on the schematic and model design according to the latest naming convention.

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For labelling of components in the field the ‘’Label convention for assets’’ need to be applied. The following positions needs to be visible on the labelling:

- Space ID or room name
- Class path asset
- Count

The type of the labels needs to be in accordance with the client specification, e.g.:

- Label material
- Text style
- Text height
- Colours

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4. SPECIFICATIONS

4.1. DESIGN CRITERIA

The following illustrates the criteria underlying the executive design on which the system choices described below are based:

- Energy saving: particular attention has been paid to the containment of energy consumption by adopting architectural solutions that involve the use of materials aimed at reducing to a minimum the dispersion by transmission and the direct radiant effect of transparent surfaces, in synergy with the proposed plant solutions that involve the adoption of equipment and systems capable of ensuring high performance.
- Management and implementation costs: the containment of management costs is one of the fundamental aspects that have guided the systems choices, favoring the solutions described in the following points of this report, with particular attention to the safety and functionality of the systems.
- Partialization: all systems are designed to allow the total hydraulic partialization of IT services and of air conditioning zone by zone, in order to allow only the use of the circuits actually used, regulate the supply flow temperatures to the devices and the relative flow rates according to specific needs, significantly reducing management and maintenance costs.
- Maintenance cost - standardization of components: particular emphasis is given to the aspect of simplification of routine maintenance operations, redundancy, the possibility of identifying any faults and the speed of intervention, which are often sources of very serious inconvenience even for correctly sized systems. Particular attention was given to the total inspectability of the equipment, concentrating them in special compartments and/or dedicated spaces.
- Reliability: the choice of materials, the simplicity of operation of the systems, the intervention logics were aimed at maximum reliability.
- Flexibility: the choices of the proposed plant typologies allow for even substantial changes to the possible variations of internal layout, type of equipment to be powered, diversified temperature control for each individual plant. The system philosophies and the quality of the components to be adopted will be chosen to obtain the best possible performance, in coordination with the needs of the Client, of functionality and of environmental well-being and healthiness.

Particular attention is paid to the design of mechanical systems dedicated to the data center areas, the so-called critical systems. In addition to the already mentioned technical aspects, the design of those systems includes the choice of low energy consumption equipment in order to obtain the maximum energy efficiency of the entire system during every period of the year, minimizing the PUE.

The design of the critical mechanical systems is developed according to the following design principles:

- Concurrently maintainable: a redundant delivery path for power and cooling is added to the redundant critical components so that each and every component needed to support the IT processing environment can be shut down and maintained without impacting IT operations. In other words, the data center requires no shutdowns for equipment replacement and maintenance;
- the system as designed will be able to have an automatic response to some faults (such as an electrical grid failure).

4.2. GENERAL SPECIFICATION

Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

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All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

4.3. CRAH

CRAH perimeter cabinet type cold-only hydronic precision air conditioner for vertical installation, in configuration with bottom displacement air delivery. Made up of two modules, the first containing the heat exchange battery and the second containing the ventilation section. Composed of a structure and paneling in galvanized sheet metal and powder coating, internal panel lining with sound-absorbing material, ventilation units with backward curved centrifugal fan of the plug-fan type, coupled with EC electric motors with external rotor of the brushless type (power supply 400 V / 3 ph / 50 Hz) with inverter for continuous variation of the rotation speed, standard G4 type filter section, electrical panel, motorized PICV regulation valve. Complete with the following accessories: BACNET serial card, dirty filter sensor, dual power supply with ATS, water outlet sensor, optimized battery. Including starters.

For detailed performance parameters refer to the design data document.

4.4. PRESSURIZATION AND DEGASSING UNIT

Pressure maintenance units with pumps, system replenishment and integrated cyclonic vacuum degassing for heating and cooling systems. Consisting of:

- Control unit for pressure maintenance with range + or – 0.2 bar, 2 pumps, 1 overpressure valve and 2 motorized valves for degassing and pressurization, 1 overpressure valve for pressurization of load peaks. For water replenishment 1 solenoid valve and 1 water meter. Including anti-condensation insulation
- Main expansion vessel with content measurement foot, including assembly set for water connection
- Discoidal static absorption vessel

For detailed performance parameters refer to the design data document.

4.5. SIDE STREAM FILTRATION

Supply and installation of continuous filtration units for cooling systems. Consisting of:

- No. 1 centrifugal pump with cast iron body and impeller, flow rate 32 m3/h and head 17.5 m, absorbed power 4 kW, power supply 400 V / 3 ph / 50 Hz, rotation speed 1450 rpm, class F, IE3 motor
- No. 1 stainless steel container for the filtering sections, with DN65 flanged hydronic connections, drain connection and no. 2 connections for pressure gauges, no. 3 PP bag filters measuring 2 x 50 micrometers
- Stainless steel AISI 304L dosing pot, lt.20, installed on the skid
- No. 2 DN65 butterfly valves, no. 2 anti-vibration joints, no. 1 differential pressure gauge for dirty filter warning
- AISI 304L stainless steel pipes
- No. 1 control panel with alarm, including monitoring from BMS via MODBUS and I/O IP alarm contact

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For detailed performance parameters refer to the design data document.

4.6. DX UNIT

Precision air conditioner with direct expansion in split system version for cooling technological environments, with evaporating unit for internal installation and condensing unit for external installation, R32 refrigerant. Composed of:

- Internal evaporating unit in steel sheet and thermo-acoustic insulation in expanded polyethylene, filtering section with COARSE 50% efficiency, finned pack exchanger with copper pipes and aluminum fin, stainless steel condensate collector and flexible PVC gravity drain, temperature probes on air intake for control and regulation, electronic expansion valve with control driver, safety pressure switch and pressure transducers, double centrifugal fan with double suction coupled to an external rotor electric motor

- Control system with microprocessor with display for monitoring operating and alarm status, with internal memory and provision for connectivity card

- External condensing unit in painted steel sheet, thermal and acoustic insulation in expanded polyethylene, finned pack exchanger with copper pipes and high efficiency aluminum fins, axial fan with AC electric motor, rotary scroll compressor with brushless inverter motor

- All exposed copper refrigerant piping (liquid and gas lines) shall be installed inside an insulated protective duct. The duct must provide mechanical protection against environmental damage (e.g., weathering, physical impact). Joints and terminations shall be sealed.

For detailed performance parameters refer to the design data document.

4.7. VRF SYSTEMS

VRF system. Consisting of:

- No. 2 external air source heat pump in vertical flow configuration, single module and with double inverter fan on the module, with external structure in galvanized sheet metal, exchange battery arranged on 4 sides, hermetic inverter compressor, power supply 400 V / 3 ph / 50 Hz. Including pre-charge of R32 refrigerant gas. Cooling performance unit 1 (standard conditions internal T 27 °C, external T 35 °C): cooling capacity 89 kW and EER 6.3; Heating performance unit 1 (standard conditions internal T 20 °C, external T 7 °C): heating capacity 77 kW and COP 4.1. Cooling performance unit 2 (standard conditions internal T 27 °C, external T 35 °C): cooling capacity 83 kW and EER 6.4; Heating performance unit 2 (standard conditions internal T 20 °C, external T 7 °C): heating capacity 62 kW and COP 4.2.
- No. 8 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 1.7 kW; heating performance in standard conditions 1.9 kW
- No. 1 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 2.2 kW; heating performance in standard conditions 2.5 kW

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- No. 3 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 4.4 kW; heating performance in standard conditions 5.0 kW
- No. 1 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 5.5 kW; heating performance in standard conditions 6.3 kW
- No. 5 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 7 kW; heating performance in standard conditions 8 kW
- No. 6 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 11 kW; heating performance in standard conditions 12.5 kW
- No. 3 4-way blow ceiling suspended unit with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 7.9 kW; heating performance in standard conditions 9 kW
- No. 1 Biddle air curtain, cassette, 2500 mm
- No. 1 centralized controller with LCD touch screen and no. 20 remote controls
- Branch joints

Including technical service for start-up.

4.8. PIPEWORK

4.8.1. Fuel pipework

A double walled HDPE piping system shall be provided with external containment as per the specification sheet or accepted adequate system of piping which shall be provided with a secondary leak containment either with double skin, bund or drip tray. All above ground pipework and where the pipework is exposed and has potential to be in contact with flames or hazardous products shall be single walled system with leak containment underneath.

Product Compatibility: All components of the piping system shall be compatible with the products to be stored, and shall be made of non-corrosive materials, or if metallic, such as the fittings and couplings, isolated from corrosion causing agents.

Structural Integrity: The outer tertiary containment system shall be of such design and materials to have sufficient strength to withstand the maximum burial loads and tested. The double-wall inner primary piping system shall be capable of withstanding liquid pressure five times greater than the designed operating pressures.

Integrity Testing: The double walled pipework's outer secondary containment system shall undergo a pressure hold test of 4 bar after installation and before the final backfill. The inner primary piping system shall be subject to a 10 bar pressure hold test prior to final backfill.

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Monitoring Capability: The design of the secondary containment system shall permit any leak in the primary piping system to be detected by a leak detection system.

Aboveground Terminations: Where pipework transition from buried to aboveground, the secondary containment pipe shall be terminated by installation of a slip closure, riser pipe and stub flange or female BSP adaptor to allow connection to metallic pipework.

Belowground Terminations: Where pipework enters below ground access chambers, the secondary containment pipe shall be terminated by installation of a slip closure and a compact flange adaptor with BSP thread to allow connection to metallic pipework. These access chambers shall meet the following requirements:

- Provide product-tight connection
- Provide product-tight pipe and conduit exits
- Provide sufficient strength to keep out surrounding backfill material
- Made of non-corrosive, product-compatible and dielectric materials

Pipework shall be run neatly, parallel to walls or grid lines on plan and shall, where necessary, set around columns and projections.

All screwed and flanged joints shall be easily accessible.

Pipework passing through internal or external dry sheet construction walls shall pass through formed holes of such size that the pipework may be removed without cutting or deforming the pipe. All holes through such walls shall be closed after the erection and testing of the pipework.

4.8.2. Cooling pipework

Cooling pipework shall be aligned with the pipework specifications and meet the following requirement:

- Welded black steel piping
- Critical cooling pipes <DN200: EN 10255-1 heavy series
- Critical cooling pipes DN200/250: EN 10216, 6,3 mm thickness
- Surface of pipework shall have corrosion protection as per EN ISO 12944: Corrosion class C3 (Medium) / Durability: High (>15 years)
- No press fittings are allowed
- No fittings to be cast in concrete

4.8.3. Pre-conditions Grooved coupling

Grooved couplings can be used as an alternative for the welded black steel piping as per the pipe work specification. To use this type of connections the following requirements needs to be fulfilled:

- Victaulic Pipe, couplers, and associated equipment pieces such as valves, bends, T-pieces etc should be used. Only Victaulic QuickVic connections can be used:
    - Victaulic Rigid couplings style 107 and W07
    - Victaulic Flexible couplings stype 177 and W77
- Grooving must be done by Victaulic grooving tools model 5200i
- Victaulic valves, strainers and suction diffusors are acceptable to be used in this system.
- Design of connection types and thermal expansions provisions should be done by Victaulic
- Design of all pipe supports should be done by Victaulic and send to the EOR for approval prior any constructions work. The contractor shall be implementing the support type and positions into the shop drawings and 3-D model

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- The whole piping system shall me modelled based on the original design by Victaulic. The contractor shall be implementing the pipe system into the shop drawings and 3-D model
- All connections and prefab elements should made in the Victaulic factory
- The number of joint in equipment connections should be reduced by using Victaulic Equipment Modules. If this can not be done welded branches should be used. The final decision of using grooved couplings or welded connections in the equipment branches is depending on the number and positions of the connections and is always up to the EOR and client
- Before construction work start all personal involved should be trained and certified by Victaulic. Certification should be visible on all involved construction workers
- A representative of Victaulic should be on-site during the whole installation, pressure testing and cleaning and flushing period for supervision and quality control
- All connections need to be tagged, labelled, and signed off by a Victaulic inspector. All inspected coupling and their conditions will be record in an inspection log
- A detailed report consisting of observations on the installed conditions of the pipe work and couplings will be handed over to the client
- The contractor is obliged to hand over a fully Victaulic certified installation

4.8.4. Pre-conditions composite piping

Composite piping can be used as an alternative for the welded black steel piping as per the pipe work specification. To use this type of pipe material the following requirements needs to be fulfilled:

- The composite piping consists of a blend of thermoplastic and glass fibre reinforcement
- Pipe should of the Oxygen Tight (OT) type. A special coating needs to be applied to create the oxygen tight layer
- The pipe needs to be protected against exposure to UV radiation. When used in an exposed to UV radiation environment a UV-resistant layer of polyethylene needs to be used
- When colour painting is required an epoxy painting can be used
- In case fire resistant walls or floor are crossed fire retardant seals needs to be used with the same fire resistance classification. The following products can be used:
    - Rockwool Fire protection pipe shell Conlit 150U
    - Flamco fire protection sleeve AWM II
- To prevent freezing of the medium, it is possible to apply tracing, as long as the maximum surface temperature of the MF-RP pipe material does not exceed 70 °C
- The whole piping system shall me modelled based on the original design by the supplier. The contractor shall be implementing the pipe system into the shop drawings and 3-D model
- The details of the system design such as pipe support positions and type, expansion provisions, connection locations and prefab details should be done by the pipe supplier
- All connections and prefab elements should made in the supplier factory or workshop
- The pipe and pre-fabrication pieces should be cleaned and protected before transported to the construction site
- All staff involved in the construction of the system should be instructed and certified by the manufacturer. Certification should be visible on all involved construction workers
- A representative of the supplier should be on-site during the whole installation, pressure testing and cleaning and flushing period for supervision and quality control
- All connections need to be tagged, labelled, and signed off by a supplier inspector. All inspected connections and their conditions will be record in an inspection log
- A detailed report consisting of observations on the installed conditions of the pipe work and couplings will be handed over to the client
- The contractor is obliged to hand over a fully certified installation

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4.8.5. Installation – Steel

Black steel sizes up to 40 mm (DN40) shall be threaded and 50 mm (DN50) and above shall be welded. No threaded connections in pipes containing ethylene or propylene glycol anti-freeze agents shall be used.

Threaded Joints:

- Screw threads shall be clean and true
- In addition, all internal threads shall be checked for quality and any with any indication of damage shall be rejected and removed from site. All pipes shall be reamed or scraped to remove internal burrs after threading

Welded Joints:

- Welding shall generally be in accordance with the relevant Section of the General Specification. All steel elbows shall be of long radius pattern except where space conditions do not permit
- The substitutions of short radius elbows shall be approved by the Clients representative
- For branches smaller than two DN sizes, tap connections are permitted, otherwise manufactured T-pieces shall be used

Welding Piping:

- Where so shown on drawings, specified or directed, welded joints, outlets and flanges shall be used. Welded joints may also be provided elsewhere, where approved by the Clients representative, except on piping smaller than DN50, or at points where it may be explicitly specified or directed to leave flanged joints in order to facilitate future changes
- All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees as appropriate.
- Cut samples shall be submitted for approval if directed. All such fittings etc., shall be of type which maintains full wall thickness at all points, ample radius and fillets, and proper bevels or shoulders at ends. In a prefab workshop, also stubs may be used for branches if possible. All job welding shall be done by the electric arc welding process
- All joints shall be of the 30-degree bevel type. Pipe shall be mill-bevelled or machine-bevelled under this section of the specifications. All scale and oxide shall be removed with hammer, chisel or file and the bevel left smooth and clean
- Pipe lengths shall be lined up straight with abutting pipe ends concentric

Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to locations of welding works shall be held together with tape or other approved means to prevent induced current in structural steel, in piping or other metals within the building.

The ground lead shall be connected to the length of pipe with a suitable clamp in such manner that the welding current will not flow through joints in pipe, structural steel of building or steel pipe supports.

Weld metal shall be thoroughly fused with the base metal at all sections. Welds shall be of sound metal, free from laps, slag inclusion or other defects.

All welders shall be certified as indicated on their “Welding Qualification Records (WQR) for the service for which they are employed and on which they work. These WQR must be handed over before start welding on site. For welders in a prefab shop, the WQR must always be available and

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must be handed over at the end of the works for all welders worked on the project together with the welding traceability records.

Wherever welded piping connections to equipment, valves, or other units need maintenance, servicing, or require possible removal, the connection joint shall be flanged. Pressure rating of the pipe flanges shall match the pressure rating of the flanges on the equipment to which the piping connects.

4.8.6. Quality of welding

The quality of welding should comply with the following standards:

- EN-ISO 15614-1: *Specification and qualification of welding procedures for metallic materials*
- EN-ISO 5817 class C: *Welding - Fusion welded joints in steel, nickel, titanium and their alloys – Quality levels for imperfections*
- EN-ISO 15607: *Specification and qualification of welding procedures for metallic materials*
- EN 287-1/ISO 9606-1: *Qualification test of welders — Fusion welding*
- EN ISO 17636-1 (formerly EN 1435): *Non-destructive testing of welds - Radiographic testing of welded joints*
- ISO 10675-1/ EN 12517-1 level 2: *Non-destructive testing of welds - Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography - Acceptance levels*
- ISO 9712: *Non-destructive testing — Qualification and certification of NDT personnel*
- ISO 3834-2: *Quality requirements for welding*

Welding Co-ordination:

- The welding technologist from the Main contractor is responsible for welding co-ordination. The welding technologist is also responsible that the welding qualification test are in accordance EN-ISO 15614-1

Approvals:

- The Welding Procedure Specification (WPS), Welding Procedure Qualification (PQR) shall be approved by the Main contractor and by the Clients representative prior to start of production welding
- The Welding Procedure Specification (WPS) shall contain all information required by EN-ISO 15607-1

Lack of penetration:

- Butt welds shall be complete joint penetration groove welds unless noted otherwise
- All welds must be 100% visual checked and meet the visual acceptance criteria of NEN-EN-ISO 5817 class C and shall be free from cracks, overlaps, and other weld imperfections

Radiographic Examination:

- Radiographic Examination shall be carried out according: EN ISO 17636-1 class B formerly EN 1435-B and ISO 10675-1/ EN 12517-1 level 2
- Random examination: radiographic examination shall be carried out on the complete welds. Ten percent of all welds shall be tested by X-ray, by an independent party. For example: 10% of random RT i.e. two complete welds out of twenty for each welder

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- Reports must provide description of the test method, evaluation criteria and procedures. All cost for testing and reporting to the Main contractor of this project
- If the weld reject ratio (= number of defective welds divided by number of inspected welds) per welder or welding Operator exceeds 5%, extent of NDE (Non Destructive Examination) shall be increased to 100% and shall stay at 100% until the reject rate per welder or welding Operator drops below 5% and stays there for five consecutive working days

Qualification of NDT personnel:

- The operators in charge of Radiographic Examination may be certified Level 1 to EN 473, ASNT, or equivalent (certification delivered by an independent body). Interpretation must be carried-out by operators certified Level 2 to EN 473, ASNT, or equivalent (certification delivered by an independent body)
- The QC technologist shall endorse all NDE reports

ISO 3834-2:

- The main contractor must proof to fulfil the quality requirements for welding according ISO 3834-2
- The main contractor shall provide qualified personnel and all equipment, tools, instrument, etc. Necessary to carry out qualification of welding procedures and welders, handling, fabrication, welding, welding inspection, installation, and testing

4.8.7. Pipes and fittings

Fittings must be installed in such a way that no damage can be done to other equipment due to leakage of connections or stuffing boxes or glands.

Fittings shall be installed with the spindle in a horizontal position, where possible, to avoid desiccation of the packing material.

4.8.8. Piping specialties

General:

- Provide factory fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option

Pipe Escutcheons:

- Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas
- Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged
- Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged

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Dielectric Waterways:

- To effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion
- Steel to copper, with thermoplastic dielectric lining
- Connection: screwed, grooved, sweat, or flanged to match pipe.
- Dielectric Flanges: Provide dielectric flanges and dielectric bolt sleeves for flanged transitions between dissimilar metal piping. Watts Series 3100 or approved equal

Unions:

- Unions shall be of type specified in following schedule:
    - Black Steel, 1-1/2” (DN40) and smaller: screwed malleable iron, ground joint, brass to iron seat
    - Black Steel, 2” (DN50) and larger: cast iron screwed flanged, flat faced, full faced gasket
    - Stainless Steel, 2” (DN50) and smaller: 16 bar maximum operating pressure, threaded union, with Vic Press 304™ ends
    - Soldered Copper or Brass Pipe, 2” (DN50) and smaller: cast bronze or copper, ground joint, non-ferrous seat with soldered ends
    - Screwed Copper or Brass Pipe, 2” (DN50) and smaller: cast brass, ground joint, brass to brass seat, with threaded ends
    - Flanged Copper or Brass Pipe, 2-1/2" (DN65) and larger: two (2) cast bronze flanges
    - Where grooved joint piping systems are utilized, unions are not required. Grooved joint couplings shall serve as unions

Flanges:

- Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted
- Type of pipe and corresponding flanges as follows:
    - Screwed Black Steel Pipelines: 50 kg. black cast iron screwed flange, flat faces
    - Stainless Steel Pipe, Class 150 stainless steel flange adapter with carbon steel back-up flange and Vic Press 304™ end
    - Welded Steel Pipe, 60kg. black forged steel welding flanges, 1/16" raised face. Use flat face when connected to flat faced companion flange

Flange Gaskets:

- Type: full faced or flat ring to suit flange facings
- Shall conform to ASTM F-104 or another relevant European standard
- Minimum thickness: 1/16”
- Flange gaskets for medium and high-pressure steam service shall be provided with metallic rim

Pipe Sleeves:

- All penetration through a fire or smoke resistant separation shall be compliant with the local standard approved method
- For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic
- Sleeves shall provide a minimum ½ inch annular clearance around pipe

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- Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint
- Steel pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs
- Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs
- Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs
- Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves. Floor sleeves to extend a minimum of 1” above finished floor
- Through exterior walls and floor on grade: 60 kg class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe

Sleeve Seals:

- All sleeves shall be sealed to prevent intrusion of moisture, dust or insects
- Underground: For sleeves passing through exterior or foundation walls, provide mechanical link seal assembly
- Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under local codes and requirements. All fire rated penetrations shall be sealed with approved system and should be certified
- Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and fire brigade
- Valve Boxes: Concrete body, cast iron cover with vandal resistant screws, extensions as required to extend full depth to valve. Valve box cover lettering shall correspond to the valve service, "Water", "Gas", "Fire", "Sewer"

4.8.9. Expansion compensators and flexible piping connections

General:

- Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Vertical piping for domestic hot water, chilled water, heating water, steam and steam condensate shall be provided with expansion joints at each floor if required based on expansion. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints on large bore piping shall be balanced so as not to exert any reaction force. Expansion joints shall not require packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select pack less expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application. Calculate axial forces caused by compensators in pressurized pipes and provide sufficient slide and anchor points
- Expansion Compensators (Pipe Compression and Extension): Multiple stainless-steel bellows and stainless-steel liner with shroud and end fittings
- Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings
- Flexible Connection for Steel Pipe (Piping and Equipment Located Outside the Building): Stainless steel hose and braid, with threaded or flanged ends
- Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source.
- Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends
- Provide steel supports to prevent sagging is required

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- Flexible Rubber Connectors (Pump Connections): Concentric spool type expansion joint, single or double arch. Chlorobutyl tube and cover. The body shall be reinforced with rectangular body rings and a minimum of six bias plies of polyester fabric. A hypolon coating shall be applied completely and uniformly to the cover:
    - For heating hot water service and critical pump connections. Furnish with fluor elastomer tube. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/Kevlar fabric
    - Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Manufacturer shall provide documentation utilizing oven aged and cold flexibility tests to verify elastomer capability
    - For chilled water, condenser water, and non-critical pump connections. Furnish with fluor elastomer tube. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/Kevlar. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension
    - Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source. For services up to 120°C.
- Expansion Joints for Grooved Piping: For piping systems fabricated from grooved pipe and couplings, use one of the following methods for expansion compensation:
    - Combination Couplings and Nipples: Provide expansion joints constructed of grooved short pipe nipples and flexible couplings, designed by manufacturer to suit intended service. Provide removable ties to hold joint compressed or expanded during piping fabrication, depending on application. Total joint end movement is dependent on the number of couplings/nipples in the joint. Select couplings and gasket materials to match balance of piping system
    - Slip-Type Expansion Joints: Provide slip-type expansion joints constructed of carbon steel pipe and couplings, designed by manufacturer to suit intended service. Joint shall be gasketed expansion joint, with grooved ends. Slide section coated with PTFE modified PPS (Polyphenylene Sulphide) coating. Joint suitable for axial end movement up to 3” (DN80). Select couplings and gasket material to match balance of piping system
- Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate

4.9. VALVES AND APPENDAGES

4.9.1. General

Valves shall be provided to isolate each item of plant and each main branch.

The Contractor shall make all reasonable attempts to ensure the manufacture of valves is consistent throughout the whole of the installation in order to minimize stock holding of spares.

All valves shall be located to provide easy access for operation and servicing. Control valves shall normally be installed in horizontal lines with stems vertical.

Ball valves shall be used on service pipelines where regulation is required and shall be supplied and fitted in positions indicated. Valves shall be of the same nominal bore as the pipeline in which they are indicated.

Valves shall always be installed in accessible locations to permit easy operation and maintenance.

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Care shall be exercised in the installation of screwed valves to avoid straining their bodies and preventing the gate or seat from closing tight.

4.9.2. Valves

Valves shall be provided and installed where required for the purpose of circulation control and isolation. Valves shall be of full-bore size to suit the service into which they are installed.

All castings shall be clean close-grained metal, free from rough projections. Screwed valves shall have heavy hexagon reinforcement threads, ample length threads and a heavy shoulder to prevent over entry of pipes. Flanged valves shall have flat faced flanges and of thickness conforming to the appropriate specifications for the respective services and drilled off-centre.

General:

- Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted
- Valves shall have pressure rating PN 16. Samples shall be provided for inspection of the manufacturing methods

Butterfly valves:

Butterfly valve with flanged LUG body in ductile cast iron EN GJS 400-15 and centered disc in nickel-plated ductile cast iron EN GJS 400-15. Sleeve in EPDM. Painting with epoxy enamel. Adjustable lever in intermediate positions and lockable. Integrated flange according to ISO 5211. For flanges EN1092 and ANSI 16.5#150. Face to face EN 558/1-20. Operating limits -10°C ÷ +120°C. Pmax 16 bar. It can be equipped with actuator, extension for road grip, visual indicator and padlock for manual reducer, micro box, limit switch kit, limit switch box and positioner. Comply with PED directive.

- Up to and DN100mm: hand lever cast iron
- From DN125 to DN400: Worm gear unit with hand wheel
- Outside installed valves shall be weatherproof and resistant to influence of UV-light

Motorized butterfly valves:

Two-way motorized butterfly valve with centered disc and lug-type body in ductile iron, epoxy enamel painting, stainless steel shaft, flanged connections PN16. Suitable for heating and air conditioning HVAC and water treatment and distribution. Control with 24 V electric actuator of the on-off or modulating type.

Ball valves:

The valves will be equipped with a blow-out stem, a lockable locking device and an anti-static device. The construction features will be the following: Body Carbon steel ASTM A216 WCB Stem Stainless steel 316 in blow-out execution Stem seal PTFE packing Ball Stainless steel ASTM A351 CF8 Double recessed PTFE gaskets to absorb temperature variations suitable for differential pressures equal to the nominal pressure Actuation Lever and threaded connections. Diameters from DN 20 to DN 50.

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Threaded Balancing Valves:

Threaded variable orifice static balancing valve with brass body. Internal: brass. Flat seal in EPDM. Handwheel position memory. The inclined seat reduces turbulence and noise. Non-rising stem. Connections for quick-fit pressure or temperature gauges. For ISO 228-1 thread. Operating limits -20°C ÷ +120°C. Pmax 20 bar. Diameters from DN 20 to DN 50.

Flanged Balancing Valves:

Balancing valve flanged with body in grey cast iron EN GJL 250. Interior: brass. Flat seal in EPDM. External and internal painting with epoxy enamel. Position memory of the adjustable handwheel. Connections for pressure or temperature taps with quick coupling. For EN 1092 flanges with ISO 5752 face to face. Available: electronic instrument for measuring flow rate and differential pressure and fittings with quick coupling string. Operating limits -10°C ÷ +140°C. Pmax 16 bar. Complies with the PED directive. Diameters from DN 65 to DN 150.

Threaded Check Valves:

Threaded check valve with body in grey cast iron EN GJL 250. Internal: brass. Spring in AISI 302. Flat seal in FKM. External and internal painting with epoxy enamel. For ISO 228-1 thread. Face to face non-standardized. Suitable for in-line installation and as a foot valve. Available: threaded sockets for drain and bypass. Operating limits -10°C ÷ +150°C. Pmax 16 bar. Minimum back pressure 0.1 bar. Comply with the PED directive.

Flanged Check Valves:

Flanged check valve with body in grey cast iron EN GJL 250. Internal: brass. Spring in AISI 302, flat seal in FKM. External and internal painting with epoxy enamel. For flanges EN 1092. Suitable for in-line installation and as a foot valve. Available: threaded outlets for drain and bypass. Operating limits -10°C ÷ +150°C. Pmax 16 bar. Minimum back pressure 0.1 bar. Comply with the PED directive.

Control valves:

- Pressure stage in drawings (PN): 16
- Control Authority: minimum of 0,3
- Materials:
    - House and gland: brass
    - Diaphragm and O-rings: EPDM
    - Valve cone spring and screws: stainless steels. Operation: Motor Accessories according section controls
    - Measuring devices: Each system, pump, hydraulic section, battery of an AHU, CRAH etc. shall be provided with an orifice for checking the flow
    - Separate contacts for position-indication (open/closed) and controls

All valves shall be:

- Labelled
- Lockable

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Valves shall be “maintenance free”, where good operation of all valves shall be maintained in time; without or with a minimum of maintenance to be done.

Any valves for future connections and hose connections for chillers shall be fitted with a spade and a blank flange, ensuring the valve can be tested for maintenance purposes and to keep fittings wet to avoid dry out.

Product Data:

- Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of balancing valve or circuit setter. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve

Shop Drawings:

- Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components

Valve Identification:

- Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body

Operators:

- Provide standard handwheel for gate, globe valves
- Provide 90-degree lever operator for ball valves
- Provide valve stem extension for lever-operated valves on insulated piping, so handle will clear insulation
- For valves sizes 2-1/2” (DN65) and larger, located more than 2.4-meter from floor in equipment room areas and mechanical galleries, provide chain operated sheaves. Provide chain and extend down to 1.8 meter above floor and hook clips on chain arranged to clear walking aisles
- For valves sizes 2-1/2” (DN65) and larger, located more than 3-meter from floor in access path for servers (corridor areas), provide chain operated sheaves. Provide chain and extend down to 2.75 meter above floor and hook clips on chain arranged to clear walking aisles
- For valves sizes 2-1/2” (DN65) and larger, located lower than the indicate in equipment room and corridor areas, provide hand wheel gear box operator

4.9.3. Valves for fuel system

Ball valves:

- Two-piece, threaded ends, bronze body, stainless steel ball, reinforced Teflon seats, blow-out proof stem, lever handle, listed for flammable liquids and LPG
- ¼ inch (DN8) to 1 inch (DN25):
    - Full port
- ¼ (DN32) inch to 3 inches (DN80):
    - Conventional port

Check valves:

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- Horizontal Swing Check Valves:
  - 2- ½ (DN65) inches and larger:
    - Cast iron body, bolted cap, bronze or cast-iron disc, renewable disc seal and seat, flanged ends
- Spring Loaded Check Valves:
  - 2 inches (DN50) and smaller:
    - Bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, threaded ends
  - 2- ½ (DN65) inches and larger:
    - Wafer style, cast iron body, bronze seat, centre guided bronze disc, stainless steel spring and screws, flanged ends

4.9.4. Thermometers

Bimetallic thermometer in stainless steel with rear stem in stainless steel 316TI for installation in well with suitable reading scale:

- 0 +100°C for pipes with high temperature operation
- 0 +50°C for pipes with low temperature operation

Dial size 44 mm.

4.9.5. Pressure gauges

Pressure gauge built according to UNI EN 837.1 standards - AISI 304 IP65 stainless steel case, diameter 40mm. Transparent polycarbonate - AISI 316 pin and movement - 1/8 gas RADIAL conical connection (ISO 7/1). Aluminum dial with white background - black BAR and Red PSI scale - Accuracy class 2.5% Aluminum pointer.

4.9.6. Strainers

Strainers shall be full line size located ahead of all pumps, chillers, air handling units and in locations as indicated on drawings. Up to 50 mm size bodies shall be bronze, screwed body," Y" type, with 37% open mesh Monel metal screen, and 1.4 mm diameter holes.

Sizes 65 mm and above shall have cast Iron body, flanged, "Y" type bolted cover flange, tapped blow-off outlet, 37% open mesh Monel metal screen, with 1.4 mm diameter holes. Metal screens should have reinforcement rings at both ends.

All separate circulating systems shall be fitted with filters and according to the specifications below:

- Steel cast housing with flanges PN16
- Stainless strainer width 0,25 mm
- Flange lid to remove or maintain strainer
- Lid with drain connection and valve
- Free flow model

4.9.7. Air vents

Air vents shall be installed at all high points in supply and return piping. Air vents shall be equipped with shut off valves.

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4.10. VIBRATION ISOLATORS

All plant and equipment shall be isolated from the building structure in such a way that noise and vibration (in particular seismic vibrations) are not transmitted through the structure.

The anti-vibration equipment must comply with:

- Outside installed vibration isolators shall be weatherproof and resistant to influence of UV-light
- Vibration isolators shall be able to limit horizontal movement but enable vertical movement
- Machines shall be adjusted and balanced whilst mounted on the vibration isolators
- Machines shall be prevented from slipping from the vibration isolator
- Vibration isolators must be applied at all applicable locations, but definitely for chillers, air handling units and all floor mounted pumps

4.11. THERMAL WATER TANKS

Insulated buffer tanks with the following characteristics:

- Material: carbon steel
- Insulation: PU-R/PE, thickness 30 mm
- Coating: PVC
- Operating limits: -10°C + 60°C/6 bar
- Installation: outdoor

For detailed performance parameters refer to the design data document.

4.12. INSULATION

All cooling system pipework shall be insulated with an airtight insulation such as Armaflex AF. All hot water distribution pipes shall be installed with insulation with a minimum thickness as per DPR 412/93. Insulation shall be continuous through supports hence insulation blocks shall be included for all support bracketry. Where pipework is run externally 2x25mm Armaflex with seams interleaved shall be provided with tracing and an aluminum cladding. All joints shall be riveted and sealed with a suitable silicon-based sealant. Where pipework runs horizontally, any longitudinal joints in the aluminum cladding shall be made in the lower quadrant only.

All Insulation material shall be at least class B-S2 / BI-S2 for flame retardant materials or class A-S1 / AI-S1 for non-combustible materials.

Heat distribution and hot water pipes and fittings are to be insulated as follows:

- In the case of lines and fittings with an internal diameter of up to 22 millimeters, the minimum thickness of the insulation layer is 20 millimeters, based on a thermal conductivity of 0.035 watts per meter and Kelvin
- In the case of lines and fittings with an inside diameter of more than 22 millimeters and up to 35 millimeters, the minimum thickness of the insulation layer, based on a thermal conductivity of 0.035 watts per meter and Kelvin, is 30 millimeters
- In the case of lines and fittings with an inside diameter of more than 35 millimeters and up to 100 millimeters, the minimum thickness of the insulation layer, based on a thermal conductivity of 0.035 watts per meter and Kelvin, is equal to the inside diameter

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4.13. FLUSHING

Water:

- Flushing points and drain points shall be incorporated in the pipework system and flushing bypasses shall be included around chillers, coils etc. Flushing velocities will be sufficient to ensure that deleterious material such as welding slag is removed from the pipework system. The flushing velocities must be in accordance with the flushing velocities given in Table 5, BSRIA. Application Guide (AG), Pre-Commission Cleaning of Pipework Systems
- Prior to flushing, all pipework systems shall be pressure tested to at least twice the working pressure with the pressure being maintained for a period of one hour

Fuel:

- All pipe work and equipment shall be cleaned with compressed air

4.14. TESTING AND BALANCING

Test holes:

- Test holes shall be provided as necessary for proper measuring and to balance the system
- Piping shall be capped with materials the same as the piping system
- Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing

4.15. WATER LEAK DETECTION AND LOCATION SYSTEM

Manufacturers:

- TTK

Product Description:

- Microprocessor based monitoring unit, sensor cable, probes, system layout map, and auxiliary equipment to provide continuous monitoring of sensing strings for leaks, shorts, breaks, and probe activation. When any of these conditions occur at any point along cable, alarm sounds, type of condition is identified, and location displayed. System monitors interstitial space of double walled tanks and pipework

Performance:

- Detect and identify location of first leak within 0.2 percent of sensor string length or 1.5 meter, whichever is greater. Identify type of alarm
- Sensing String Length: Monitor up to 1.5-meter feet of cable for each sensor string from single monitoring unit
- Multiple Leaks: Detect and locate multiple leaks or additional liquid on sensor cable
- Breaks and Shorts: Identify location of breaks and shorts on cable. When faults occur, sound alarm, and display on front of monitoring unit type of fault and location of fault
- Liquids Detected: Detect liquids, including aqueous, hydrocarbon, conductive, and nonconductive liquids
- Remote Annunciation: Furnish relays for remote indication of alarm conditions. Relays indicate no alarm conditions exist, alarm condition exists but has not yet been acknowledged, and alarm condition exists and has been acknowledged. Communications available via RS-232 and ASCII communication protocols to allow central point monitoring and control via remote computer

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- Archives: Record significant events in non-volatile memory with capacity of 900 events. When memory becomes full, recorded events are deleted from memory on first-in-first-out basis. Each recorded event includes time and date event occurred
- System Status: Continuously give positive indication of monitoring sensing string and status of sensing string. System clock indicates time and date on LCD of monitoring panel. System clock is programmable. Include time and date indication for events recorded in memory
- Security: Assignable password security for varying levels of system access. Minimum of 20 passwords available within system. System to not allow unauthorized modifications to sensing string to be made without causing alarm condition
- Sensor Types: Capable of monitoring sensor cables, probe sensors, and switch sensors such as float switches, and pressure switches, from same monitoring panel. English language displays indicate status of sensors
- Sensitivity: System to not detect incidental liquid contact. Sensitivity field adjustable to increase or decrease amount of wetted cable needed to cause alarm

Components:

- Monitoring Unit:
    - Indicates when liquid comes in contact with sensor cable by sounding alarm, actuating output relays, displaying message leak has been detected and giving location of leak on sensing string
    - Unit furnished with green LED on panel front indicates unit is powered. Furnish two line by forty-character backlit LCD visible from front of unit to provide system data. Red LED on panel front indicates alarm condition has occurred. Unit power requirements: 120/240 VAC, 100 VA, 50/60 Hz, single phase. Equip with RS-232 communication port and minimum of one common and one SPDT output relay for each cable, rated for 250 VAC, 10 amp
    - Enclose in modified NEMA 3 / IP54 type enclosure. UL listed to provide connections for intrinsically safe sensor circuits for use in hazardous locations. Ability to locate leak does not depend on battery backed up functions. In event of power failure, store system conditions and parameters in non-volatile memory allowing unit to automatically resume monitoring, without resetting, upon restoration of power. Furnish on-off switch in panel
- Sensor Cable: Coaxial construction consisting of insulated copper centre conductor, spacer material, and outer braid. Centre conductors not less than 20 AWG for mechanical strength. Cables field repairable

4.16. GLYCOL LEAK DETECTION

To be installed on the roof to spot eventual glycol leakage from chiller free-cooling loops.

Consist of:

- Stainless steel drip trays
- Conductivity sensors able to detect glycol inside water
- Motorized ball valves with open-close control, fail-to-close
- Control box for outdoor installation, with alarm to be reported to BMS.

4.17. MANUFACTURER'S FIELD SERVICES

Pumps:

- The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify pump systems mounting, verify piping installation, verify control wiring, verify power wiring,

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and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the jobsite

Leak detection:

- Furnish factory trained representative of system supplier for 16 hours of on-site time during leak detection and location system sensor and electronics installation
- Furnish factory trained representative of system supplier for 8 hours of on-site time during final checkout of leak detection and location system

Packaged split systems, Package Chiller and Heat pump:

- Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance
- Schedule 4 hours training with Owner, with at least 7 days' advance notice

Aboveground tanks:

- Furnish factory trained representative for 16 hours of on-site time during aboveground tanks installation
- Furnish factory trained representative for 8 hours of on-site time during final checkout of aboveground tanks installation

4.18. AIR HANDLING UNITS (DOAS)

4.18.1. General

All accessible sections shall be provided with lighting fixtures, lighting fixtures to be operated with switch on the outside of the DOAS's.

All control equipment shall be placed in the airstream and need to be accessible with the section.

Condensation connections to be equipped with a special overpressure siphon and shall be connected to the drain system.

The floor of the DOAS's shall be plated with stainless steel, to prevent corrosion.

The equipment manufacturer shall strictly adhere the following standards & specification:

- Energy efficiency requirements for DOAS related 2016 regulations
- ISO 9001 certificate required.
- CEN (Committee European de Normalisation) standards
- SIA 382-1
- Efficiency class IE3 for electrical motors
- DOAS's shall meet the EUROVENT CERTIFICATION requirements of:
  - Casing strength to CLASS 2A
  - Casing air leakage L2
  - Thermal transmittance CLASS T2
  - Thermal bridge factor CLASS TB2

The DOAS manufacturer shall guarantee that no condensation shall take place on the exterior of panels. In the event that any condensation problems appear after installation, the Main contractor shall undertake all remedial measures to rectify and to the satisfaction of the Clients representative. Any stacked or double height coils shall have separate drain pans to reduce carry over.

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Vibration Isolation:

- The Air Handling Unit shall have internal vibration isolation system by mounting fan, motor and drive assembly on spring isolators. The fan discharge shall be connected to the air handling unit casing through canvas connection to prevent vibration transfer. In addition to the above the entire unit shall be mounted on additional vibration isolators

Filter Section:

- Filter cells shall be of standard sizes and shall be obtained from reputed European manufacturer. The filters shall be sealed against the filter frame using a permanently elastic gasket to a standard compatible with the filter efficiency
- Pressure drop tapings shall be fitted to allow manometer or filter monitor to be connected. Filter materials shall be flame-retardant, incombustible, non-odorous and offer no sustenance to vermin. Each filter section has to be provided with manometer

Bag Filters:

- Bag filters shall be high performance extended area disposable type filters Class M5 and F7 (EU7). Each filter shall consist of high-density glass microfiber media with a chemically bonded backer, individual pockets and a corrosion resistant stainless-steel enclosing frame. The filter unit shall be completely factory assembled and shall be classified by underwriter's laboratories
- Pockets shall consist of glass micro fibres chemically bonded to a reinforced backing
- They shall be sewn with a tapered stitch which forms a 'V' or wedge-shaped pocket resulting in uniform velocity in the passages of the air entering and air exiting sides of the filter. The pockets shall be equipped with a minimum of 40 support points per square foot of the filter media. All stitching points shall be completely sealed with foam seal or equivalent. The pockets shall be chemically adhered around the periphery of the galvanized steel retainers
- Retainers shall have rolled edges to reduce possible cuts to media, or lacerations to installers

4.18.2. Fan and fan motor

Fans shall be non-overloading type with galvanized steel casings. Fans shall be tested in accordance with AMCA 300-85 and shall conform ISO 1940/L. Every individual fan shall be run before delivery to check bearing condition and vibration. Impeller should be coated with 60-micron epoxy painting of high quality.

The fan shall be connected to the outlet opening by means of an airtight flexible connection. Fans shall not exceed a maximum outlet velocity of 10 m/s.

The degree of protection shall be IP54 with mounting method B3 and Class F insulation.

Fan bearing shall be re-lubricated type with extended lube lines to terminate outside the fan section. The bearing shall be selected for life of 200,000 Hours operation. Fan drive shall be rated at 150% of the maximum motor power of the units and shall be fitted with adjustable belt tension arrangement. Belt guards or screen protection door in Fan section shall be provided in accordance with CEN Standard.

Each motor that’s driven by a Variable Frequency Drive must be provided with internal thermistors for overload protection and electrical insulated bearings.

The fan motor shall be suitable for operating 400V, 3Ph, 50Hz electrical power supply. The fan motor shall be wired to the safety isolation switch or connection box.

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The Main contractor shall select power input and speed of the fan after ascertaining system static pressure in accordance with pressure drop calculations to the approval of the Engineer.

The fan shall meet the safety requirements of the CE marking.

The motor shall be mounted on a common, torsional rigid, galvanized steel base frame. The fan and motor assembly shall be isolated from the casing by means of spring anti vibration mountings selected to suit the speed of the fan and designed for 90% isolation.

4.18.3. Critical DOAS

Air handling unit for primary air. With the following treatment sections on the delivery line:

- External air intake with on-off motorized damper
- Bag filter (efficiency M5 – ISO Coarse 65%) length 535 mm
- Empty section for maintenance
- Bag filter (F8 – ISO ePM 70%) length 535 mm
- Empty section for maintenance
- Rotary heat recovery unit with thermal efficiency > 75% and enthalpic efficiency > 65%
- Mixing section with motorized damper
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Direct expansion heat exchange battery with copper tubes and aluminum fins in 11 rows, refrigerant type R410A, cooling capacity 53 kW and heating capacity 22 kW
- Electric post-heating battery, thermal capacity 13 kW
- Steam humidification with RTS humidifier, nominal power 20 kW
- Empty section for maintenance
- Air supply with on-off motorized damper

Return line:

- Air return with on-off motorized damper
- Bag filter (efficiency M5 – ISO Coarse 65%) length 535 mm
- Empty section for maintenance
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Mixing section with motorized damper
- Rotary heat recovery unit with thermal efficiency > 75% and enthalpic efficiency > 65%
- Empty section for maintenance
- Air exhaust with on-off motorized damper

Including external direct expansion unit, regulation and control panel on the machine, humidifier, inspection doors and internal lights, stainless steel floor and stainless steel internal frames, regulation and control field elements, connection cables, MODBUS communication to the BMS system.

For detailed performance parameters refer to the design data document.

4.18.4. Admin DOAS

Packaged air handling unit for primary air with fully integrated refrigeration/heat pump cycle and adiabatic heat recovery.

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With the following treatment sections on the delivery line:

- External air intake with on-off motorized damper
- Pocket filter (G4 – ISO ePM 55%) length 50 mm
- Bag filter (F7 – ISO ePM 70%) length 300 mm
- Rotary heat recovery unit with thermal efficiency > 85% and enthalpic efficiency > 65%
- Direct expansion heat exchange battery with copper tubes and aluminum fins in 26 rows, refrigerant type R454B, cooling capacity 49 kW and heating capacity 35 kW
- Steam humidification with RTS humidifier, nominal power 12 kW
- Direct expansion heating battery with copper tubes and aluminum fins in 13 rows, refrigerant type R454B, heating capacity 26 kW
- Electric post-heating battery, thermal capacity 11 kW
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Air supply with on-off motorized damper

Return line:

- Air return with on-off motorized damper
- Pocket filter (efficiency G4 – ISO Coarse 55%)
- Rotary heat recovery unit with thermal efficiency > 85% and enthalpic efficiency > 65%
- Indirect adiabatic cooling for heat recovery
- Direct expansion heating battery with copper tubes and aluminum fins in 10 rows, refrigerant type R454B, heating capacity 26 kW
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Air exhaust with on-off motorized damper

Including regulation and control panel on the machine, humidifier, inspection doors, regulation and control field elements, connection cables, MODBUS communication to the BMS system.

For detailed performance parameters refer to the design data document.

4.19. FANS

All fans shall be complete with:

- Manufacturer: see spec sheet
- Type: axial fan for in line mounting with duct
- Aluminium blades
- Thermostatic control variable speed by frequency control when controlled on room temperature (transformer room, mechanical plant room)
- Mounting feet and anti-vibration mountings, for horizontal or vertical operation
- Matching flanges
- Flexible connectors
- Inlet cone
- Isolation switch
- Electrical isolation

Arrows indicating the correct rotating and direction of airflow shall be mounted on the outside of the fan casing.

All fans shall be monitored and controlled.

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For detailed performance parameters refer to the design data document.

4.19.1. Smoke extraction fan

Axial smoke extraction fan for smoke transport with temperature class F400, with vertical flow upwards, with body in steel sheet, painted and thermally insulated, aluminum blades, motorized shutter with watertight closure. Motor with power supply 400 V / 3 ph / 50 Hz, efficiency class IE3, ISO class H, protection IP55. For installation on flat or pitched roofs and assembly with ducted intake and free expulsion. Including the following accessories: thermally insulated roof protection, rain hood, equipotential connection.

4.19.2. Supply fan for smoke extraction system

Horizontal flow axial fan for fresh air supply smoke extraction system, with painted sheet steel body, 9-blade sheet steel impeller. Motor with 400 V / 3 ph / 50 Hz power supply, IE3 efficiency class, ISO F class, IP55 protection. For outdoor installation with free suction and ducted pressure side. Including the following accessories: casing extension with inspection door, duct with damper, mounting feet, equipotential connection.

4.19.3. Wall fan

Axial fan with square frame and air flow from impeller to motor, frame in anti-corrosive material, impeller with wing profile blades in plastic resins, protective net, protected steel motor holder, maximum temperature 50 °C, single-phase motor power supply 400 V / 3 ph / 50 Hz. Including gravity shutter, spacer and protective net.

4.19.4. Inline fan

In-line centrifugal fan for small flow rates, pressed steel casing, epoxy powder coated, high-efficiency, low-noise backward curved blade impeller, plastic box for electrical connections, IP54 protection, maximum temperature 60 °C, single-phase motor, power supply 230 V / 1 ph / 50 Hz. Including silenced box, speed regulator, damper and collar.

4.19.5. Roof-mounted fan

Vertical-throw centrifugal extraction tower for the extraction of stale air, with frame and protective cap in galvanized steel, centrifugal impeller with backward-facing blades in galvanized sheet metal, 4-pole single-phase motor, power supply 230 V / 1 ph / 50 Hz and speed regulator.

4.20. DUCTWORK

Ductwork fabrication and hanging shall be as described in the Italian standards. The ductwork systems (air ducts, plenums, casings etc.) shall be constructed of lock performing galvanised steel sheets and complete with all necessary dampers, silencers/attenuators etc.

Ductwork shall be installed in a workmanlike manor and shall facilitate maintenance of all item’s op plant and equipment. The ductwork shall not create obstructions to the free movement of personnel.

During installation the open ends of ducts shall be protected with blank, flanged sheet metal baffles, securely attached to prevent debris and dirt from entering.

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At each main branch of the ductwork and at each fan discharge and suction the Main contractor shall provide sufficient number of test holes to allow balancing. Test holes shall also be provided at all equipment.

General requirements:

- Construct all ducts and plenum of gauges, and with joints, bracing, reinforcing, and other construction details in accordance with the latest construction standards previously listed
- Duct dimensions indicated on drawings are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions
- Ducts shall be constructed of material gauges and reinforcement to meet 150% of the pressure requirements for external static pressure scheduled on drawings for the fans serving each system
- Internal insulation is not allowed

4.20.1. Sheet metal material

General Material Requirements: Comply local Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

Galvanized Sheet Steel:

- Galvanized Coating Designation: G90
- Finishes for Surfaces Exposed to View: Mill phosphatized

Tie Rods: Galvanized steel, 6mm minimum diameter for lengths 900mm or less; 10mm minimum diameter for lengths longer than 900 mm.

4.20.2. Ductwork fabrication

Joints – Sealant:

- Outdoor ductwork: Solvent-based and oil-based sealants
- Indoor ductwork: water-based sealant. Flexible, adhesive sealant, suitable for high velocity and high-pressure applications

Hard cast Iron Grip.

Two-Part Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermally with tape to form hard, durable airtight seal.

Joints - Rectangular Ducts:

- Slip drive joints, standard seams, flanges or welding

Joints – Round:

- Exposed Ductwork: Slip drive and sheet metal screws
- Concealed Ductwork: Sheet metal screws

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Elbows:

- Construct long radius elbows with center line not less than 1.5 times the duct width. Shorter radius elbows may be used where required to fit in restricted spaces, or as shown. Provide single thickness turning vanes on all short rectangular radius elbows less than 25" wide. Provide double thickness turning vanes for short rectangular radius elbows 25" wide and greater. Elbows with square throat and radius heel are NOT allowed

Transitions:

- Construct transitions with minimum slope of 1 to 5 ratio

Branch Connections:

- Provide 45° entry boots or radius taps for rectangular duct take-offs and conical or bell mouth taps for round duct take-offs. Straight 90° taps are not allowed, except where round take-off duct size equals round branch duct size. Provide volume dampers at take- offs for balancing if not specifically noted as provided at outlet or inlet. Provide insulation guards at transitions to lined ductwork

4.20.3. Rectangular ductwork

All ductwork must comply with all local, code requirements. Ductwork shall be constructed of galvanized steel. Diagonally cross break all panels on ducts 750mm wide and larger, or bead using automatic bead machine with beads at 300mm on centre or less. All connections shall utilize 45° boot take-offs. Bullhead tees and straight taps are not permitted.

4.20.4. Round ductwork

Spiral lock seams, only. Lap or snap lock seams are not permitted for round ductwork of any size. Provide beaded sleeve joints or flanges with gasket joints. All elbows shall be long radius type with centreline radius to duct diameter of 1.5, exceptions will only be allowed at restricted space locations. All connections shall utilize welded conical tees. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Flat oval shall be utilized in space- restricted areas.

4.20.5. Flexible ductwork

Flexible round ductwork insulated with 25mm thick insulation may be utilized where shown on the Drawings and at the last 1.5m to each air outlet and inlet, unless shown otherwise on the plans. Maximum of only one 90° bend in any length. No intermediate joints are allowed. Connect each end with plastic draw bands. Support duct to maintain smooth shape without sagging. All connections shall utilize welded conical tees, aluminium conical fitting with damper or 45° boot take-offs. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

Flexible ductwork for low pressure systems with positive static pressure at or below 500Pa positive pressure shall be a trilaminate of aluminized foil, fiberglass insulation, and aluminized polyester, mechanically locked to galvanized steel helix without adhesives, exterior 1” fiberglass insulation and fire-retardant plastic outer jacket.

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4.20.6. Plenums and equipment casings

Construct casings and plenums in conformance with the pressure and leakage classification of the ducting system.

Minimum Pressure Class: Unless otherwise indicated construct plenums and casings to withstand either a negative or positive static pressure of 1.000 Pa.

Single-Wall: Provide single-wall, casings and plenums where indicated on the drawings.

Use steel-angle-reinforced standing-seam construction.

Construct for static pressure indicated or for the maximum fan static pressure whichever is less.

4.20.7. Ductwork specialties

General: where specifically called for, materials for use in fabricating ductwork specialties shall be identical to that used to fabricate ductwork.

Ducts through roof shall be minimum 1.6 mm flashed and counter flashed and provided with storm collars to secure a watertight construction.

Bird Screens: ½", galvanized wire mesh, set in a galvanized steel frame, screw set.

4.20.8. Duct Insulation

Ducts shall be externally insulated with fire resistant (FM Global approved) Dust & Fibre free Armaflex/Climacover (Contractor to submit for approval by engineer) insulation of thickness as per spec sheet including vapour barrier. Insulation shall be self-adhered to the duct surface or by means of supplier approved adhesive contact. All protrusions and cuts through the insulation shall be sealed for the full insulation thickness. Joints in the insulation shall be taped by means of an approved tape type of the same quality as the vapour barrier and with a minimum overlap 50 mm. No vapour seal shall be left punctured.

Ducting exposed to the weather elements shall in addition to the Armaflex Insulation be cladded externally and labelled as per the insulation specification sheet.

All supply air components such as air terminals, duct accessories, flex ducts and plenum boxes internal to the admin building, shall be thermally insulated to match the duct insulation thickness.

Duct hangers shall not be covered with insulation. Hangers shall be removed one by one when applying external insulation. Insulating material shall be fixed to the duct with adhesive and strapped or clamped at intervals not exceeding 300 mm. Mechanical fastener pins may also be used on duct. Mechanical fasteners shall not penetrate the duct. The Contractor shall reinstate the integrity of the vapour barrier after the pins have been fixed.

All insulation material shall be compliant with Italian Regulations.

4.21. DAMPERS

4.21.1. Balancing dampers

Volume control dampers shall be installed in accessible locations at all branch connections and wherever necessary to adjust the flow of air to secure correct distribution. Casing and blades shall be made of galvanised sheet metal and shall be equipped with an approved device for fastening in

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any desired position. This device shall be such that the damper cannot move, or rattle and a pointer shall indicate the position of the damper from the outside of the finished duct insulation.

Dampers shall be of the aerofoil multi leaf opposed blade type with a blade height not more than 180 mm.

All blades shall be operated by a single operating quadrant with gears and links as necessary.

Spindles shall be non-corrodible, passing through bearings made of special plastic temperature resistant to 100 deg. C. Capped bearings shall be provided on the non-drive side.

The whole damper assembly shall be mounted in a galvanized frame with flanges.

4.21.2. Control dampers

Shut off and control dampers shall be installed as required for the proper functioning of the system under normal operation and according to the diagrams, layouts and this document.

- All rectangular control dampers shall be opposed blade
- Low leakage dampers
- Casing shall be galvanized sheet steel
- Blades shall be of natural anodized extruded aluminum
- Blade tip seals shall be silicon rubber
- Side seals shall be stainless steel
- External blade linkage shall be stainless steel
- Blade spindles shall be in stainless steel supported in plain brass bearings
- Shut off dampers shall have perforated blades to allow for minimum room ventilation when blades are in closed position
- The actuator shall be fixed in the factory and certified for proper operation

4.21.3. Backdraft dampers

Damper Types:

- Heavy Duty Backdraft Dampers: Provide counterweight type complete with frame, end bearings, counterbalance assembly, blades, and linkage. Pressure drop to be no more than 50 Pa at 5 m/s. Install at outside air intakes, exhaust outlets, and where shown on Drawings.

Manufacturer: see spec sheet

Application Requirements:

- Outside Air Intakes except where a control damper is required – Heavy Duty Backdraft Damper
- Exhaust openings except where a control damper is required – Heavy Duty Backdraft Damper

4.21.4. Fire and smoke dampers

The duct sections around fire dampers shall be enlarged to allow 100% unrestricted duct area while in the open position.

Approved type access doors, with airtight gaskets, shall be provided for the inspection and servicing of fire dampers.

All fire dampers shall have open/closed monitoring contacts.

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Provide fire dampers in all ducts in area, in the following locations, whether specifically or required by ordinances and codes:

- Duct entering and leaving fire shafts (duct shafts)
- Ducts passing through designated fire walls
- Ducts through floors, and not encased in fire shaft

Where fire dampers are located remote from the partition, the duct between the fire damper and the partition shall be encased in certified fireproofing acceptable to the local authorities having jurisdiction. In addition, all supports to fire-rated ductwork shall be up rated for the additional loading imposed by the fire rated insulation and to achieve the required structural integrity period.

All fire dampers except for the dampers related to transformer cooling shall be motorized. The fire valves shall be controlled by the fire alarm panel.

All fire dampers shall be of low noise and low resistance.

General:

- Provide a certified tested 2 hour rated fire dampers at 1.5-hour and greater penetrations
- Provide a certified and tested 1 hour rated fire dampers at less than 1-hour penetrations
- All dampers to be certified under the latest local Standard and requirements. Certification based on former non-current standards is unacceptable
- All damper installations to conform with fire regulation and manufacturer's installation instructions. Details on plans are shown for reference only
- Install in ducts passing through walls, floors, and ceilings as required by code. Refer to Architectural and Mechanical plans for damper locations
- Provide fire and fire/smoke dampers in locations as required by code
- Provide sleeves, slip joints, retaining angles, duct access doors, ceiling access panels, etc., as required to check and service the fire dampers. Slip or break away joints are not allowed to be taped or sealed. Access doors shall be tight fitting hinged or sliding and shall have 1" high label reading "FIRE DAMPER” or “FIRE/SMOKE DAMPER”
- All dampers to be designed for use in dynamic systems
- Dampers shall be rated for Leakage Class I. Leakage Class II may be used if damper size is smaller than available Leakage Class I dampers
- Dampers shall be certified for use by local authorities
- Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error. Do not install actuators in area where moisture can penetrate actuator or where temperature exceeds 50 °C
- All fire dampers shall be sized to provide equivalent free area through the damper equal to the connecting ductwork, or larger. Upsize fire damper as required. In no case is the damper pressure drops to exceed 60 Pa, but ideally less than 25 Pa, as designed for in total system static pressure allowance.

Combination Fire/Smoke Dampers:

- General Requirements:
    - Install at rated corridor wall or ceiling penetrations, occupancy separation walls, area separation walls and where shown on plans. Low leakage fire/smoke damper (Leakage Class 1 unless otherwise stated below) with electric actuator. Actuator shall be attached to sleeve outside of air stream. Fire/Smoke damper shall be equipped for vertical wall penetrations with manufacturer supplied sleeve and fail closed on loss of power. Each damper shall be equipped with a controlled 15 second electric heat-actuated release device. This device is to be equipped with a push-button reset. No manual fusible links are permitted. Manufacturer shall provide factory assembled

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sleeve of 16" minimum length. Installation shall be in accordance with damper manufacturer's instructions. Coordinate power and smoke detector connections with electrical installer. Integral smoke detection and actuating devices may be used if listed and approved for such service. Comply with building code requirements. All combination smoke and fire dampers shall automatically reset from closed to open position upon the reapplication of power to actuators

- Actuators: All gear and housing shall be steel. The actuator shall be direct coupled and employ a steel toothed cold-weld clamp for connecting to damper shafts. Aluminum clamps or set-screw attachments are not acceptable. Actuator shall be certified and manufactured under ISO 9001 quality control
    - Actuator shall carry a manufacturer's 5-year warranty
    - Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. Actuator shall be incapable of burning out if stalled before full rotation is reached
    - Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error
    - Actuator shall draw no more than 0.23A at 120V running, or 0.1A holding at 120V (27 VA and 10 VA respectively for 24V power) for 70 in-lb torque
    - Stall and instantaneous type actuators are not acceptable
    - Do not install in area where moisture can penetrate damper or actuator nor where actuator temperature exceeds 50 °C
    - All smoke and combination fire and smoke dampers shall be provided with Belimo Air controls FSNF120 (-S), FSNF24 (-S) actuators, or approved equal
    - If a Honeywell ML-4115 actuator is submitted as an alternate, it must be provided with a time delay relay to cause the actuator to reset to drive open mode on momentary loss of power for less than 3 seconds

Required Options:

- Provide open or closed indicator option assembly consisting of a single pole and a double throw switch used to indicate damper blade position. Output from switch to position indicator light (LED) is by automatic temperature control contractor. Include switch mounting bracket, crank arm, blade bracket and linkage from blade to the switch
- Provide a test module to permit test cycling of the damper/actuator in the field
- Provide integral smoke detector OR for overflow dampers
- Provide and field install smoke detector. Electrical installer shall wire
- For exposed wall applications provide matching wall grille to maintain appearance and fire

4.22. GRILLS AND LOUVERS

4.22.1. Louvers

Louvers are generally to be specified in the Arch. Where louvers are not covered on architectural plans and specifications, contractor is to provide under the following specification:

- Louvers to be 35° drainable fixed blade design, constructed of galvanized steel or extruded aluminium, or as specified on the plans
- Provide with ½" x ½" galvanized mesh bird screen mounted on backside of louver
- Finish/color per architect/engineer's review
- Manufacturer: per spec sheet

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4.22.2. Diffusers, grilles and registers

Diffusers shall be arranged for flush mounting in lay-in type ceilings and overlap mounting in plaster, mineral tile and similar ceilings.

All diffusers, grilles and louvres shall be supplied complete with factory powder coated finish. The finish colour shall be to the approval of the Architect. The interior of all grilles and diffusers is to be factory painted matt black.

All grilles and diffusers shall have a foam rubber sealing band around the edge to seal to the structure. Grilles and diffuser materials shall be aluminium extruded sections, unless otherwise specified. Sections in the airstream shall be carefully selected to minimize turbulence.

Grilles shall be complete with opposed blade dampers painted matt black and shall be fixed with universal mounting brackets. Both the damper and the fixing brackets shall be accessible through the face of the grille.

Ceiling Diffusers shall be multi-cone giving 4-way horizontal discharge.

The diffuser shall be complete with an opposed blade damper painted matt black.

Supply grilles/diffusers installed shall be located to ensure adequate ventilation of the rooms and shall not allow stagnant pockets of air to form. Face velocities shall be chosen to give adequate throw whilst preventing draughts within the room.

All diffusers, grilles, and registers shall be selected to provide proper air distribution for the intended occupant application. All supply air devices shall be selected to provide a maximum air velocity of 0.25m/s at three feet above the floor, unless otherwise noted. Manufacturer's representative shall carefully review Architectural and Mechanical drawings and ensure diffuser/grille/register selections will provide proper air distribution at NC 25 or less. Manufacturer at no additional expense to the Owner shall replace diffusers, grilles, and registers not providing proper distribution or excessive noise at scheduled airflow.

All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper where individual duct mounted balancing dampers are not provided.

4.22.3. Linear slot diffusers

Linear diffusers with supply or return slots, with adjustable anodized aluminum profile deflectors with a high induction ratio (mixing capacity) between the supplied air and the ambient air. Made of anodized extruded aluminum profiles coupled to obtain multiple slots inside which adjustable aluminum deflectors are housed. The flow of the supplied air can be oriented in a right, left or alternate direction, by varying the position of the deflectors.

The air flow can be adjusted by means of a calibration damper on the terminal, which can be operated from the outside with the diffuser installed without any disassembly.

The diffuser will be equipped with a conveying plenum with upper or lateral connections depending on the installation; the quantity and section of the connections will depend on the flow rate and size of the individual diffuser.

Construction in anodized aluminum or white painted aluminum RAL 9010 or another color chosen by the DL.

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4.22.4. Supply grilles

Supply grilles with double series of adjustable fins; it must be supplied complete with a calibration damper of the type with opposing fins with adjustment that can be performed from the outside of the vent, a counter frame for fixing to the duct or for any masonry and possibly a plenum. The grille will be made of extruded aluminum, anodized in natural color or painted with a color chosen by the DL, while the calibration damper and the counter frame will be made of galvanized steel sheet. The grille will be fixed to the counter frame using clips or self-tapping chrome screws that are not visible; during assembly, it will be sufficient to drill holes in the counter frame corresponding to the holes provided on the grille frame, screw the grille and seal the perimeter (in the case of applications outside the building). The grilles may be square, rectangular or circular in shape depending on what is indicated in the design documents; the dimensions of the hole to be provided correspond to the nominal dimensions of the grille.

4.22.5. Return grilles

Air intake grille with a single series of fixed fins; it must be supplied complete with a calibration damper of the type with opposing fins with adjustment that can be performed from the outside of the vent, a counter frame for fixing to the duct or for any masonry and possibly a plenum. The grille will be made of extruded aluminum, anodized in natural color or painted with a color chosen by the DL, while the calibration damper and the counter frame will be made of galvanized steel sheet. The grille will be fixed to the counter frame using clips or self-tapping chrome screws that are not visible; during assembly, it will be sufficient to drill holes in the counter frame corresponding to the holes provided on the grille frame, screw the grille and seal the perimeter (in the case of applications outside the building). The grilles may be square, rectangular or circular in shape depending on what is indicated in the design documents; the dimensions of the hole to be provided correspond to the nominal dimensions of the grille. Where provided, as per design specifications, the grills will be equipped with an openable filter holder (push-open) complete with built-in frame and filter cell. Frame and grill can be separated for ease of installation.

4.22.6. External grilles for air intake and exhaust air

Made of a sturdy structure in natural anodized extruded aluminum, composed of a frame, a row of fixed horizontal fins inclined downwards, with a special anti-rain profile and pitch of the fins is 30/50/100 mm, depending on the front section and, where required by a plenum; the union between fins and frame will be made with a mechanical system.

Installation by means of visible screws on the frame, through pre-arranged holes; complete with walled-in counterframe and insect net.

4.22.7. Suction valves

The suction valves for the extraction of toilets must be made of a front part in sheet steel, electrostatic epoxy paint (similar to RAL 9010, thickness 60 µm), threaded rod and nut in galvanized steel, mounting subframe in galvanized sheet steel. The ventilation valves must also be equipped with a central disk and a collar, with a gasket on the perimeter edge that guarantees perfect positioning of the valve in its seat. The flow rate must be adjusted by rotating the central disk.

The sizing was done by imposing that the load losses, in the central position of the adjustable element, do not exceed 50 Pa.

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4.23. DUCT SMOKE DETECTORS (DSD)

Duct mounted photoelectric smoke detector. One required for each heating or cooling system supplying air in excess of 3.000 m3/h, for systems serving more than one occupancy type, and for control of each combination fire/smoke damper when not controlled by wide detection system. Coordinate with electrical installer for power to smoke detector. Detector shall be mounted in the supply air ductwork downstream of the air handler and filters, an at the air intake. Coordinate with control installer to assure that detector shall shut down the air-moving equipment when smoke is detected and closely associated damper actuator(s). Sensor shall be selected to operate with air velocity rating from 0.5 to 20 m/s. Provide with metal sampling tube. Provide remote test and reset station at ceiling or as otherwise indicated. Duct smoke detector shall be installed in compliance with the applicable mechanical or building code.

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5. VENDOR LIST MAIN EQUIPMENTS

CRAHs:

- Vertiv
- Stultz
- Mitsubishi

AHUs:

- Roccheggiani
- Euroclima
- SAMP

Pressurization/Degassing units:

- IMI
- Flamco

Side stream filters:

- FAM Group

DX systems:

- Daikin
- Mitsubishi

VRF systems:

- Daikin
- Mitsubishi

TES tanks:

- Fiorini
- Sile

PICV valves:

- IMI
- Danfoss
- Bray

Water leak detection:

- TTK (Temar)

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Glycol leak detection:

- GUS (Temar)
- AuRü

Vacuum fuel leak detection:

- Greenline

Fuel cabinet and fuel monitoring:

- Greenline

Fuel underground tanks:

- DEMO
- Righetto

Smoke extraction fans:

- Systemair
- TROX

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MIL07

Via Lombardia 1, Siziano, MI, Italy

STACK INFRASTRUCTURE

Specification - Main Mechanical and Plumbing Equipments - Design Data

MIL07-DBA-AZ-XX-SP-M-50020

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1. INTRODUCTION

This report describes the design data of the main mechanical and plumbing equipments for the WS3 procurement phase of STACK MIL07 Data Center project. The DC has a total design IT power of 12 MW.

1.1. INSTALLATION PHASING STRATEGY

Critical systems and equipments will be installed in 2 phases, each phase is for 6 MW IT (1 DH for each phase). At full build-out the building will consist of 2 DH (6 MW each), for a total IT load of 12 MW.

The 2 critical phases are almost identical for mechanical installations, the only main difference is on the cooling generation where the redundancy is shared between the whole building

All cold drinking water and domestic hot water supply pipes will be laid in phase 1, except for the filling line for the critical chw system of phase 2 and the water taps installed on the chiller platform of phase 2.

All drainage pipes relating to the plumbing systems, both main and secondary, will be installed in full in phase 1.

The mechanical and plumbing installations for the non-critical area (offices and storages), will be installed in phase 1.

1.2. OFCI EQUIPMENTS

The critical mechanical equipments considered as free client deliveries are:

- Chillers
- DH Fan Wall units
- HVAC and plumbing equipments of the electrical pods (CRAHs, DX units, fans, leak detection…etc)
- Fuel pump of the gensets and other mechanical/plumbing equiments installed inside the genset container

The scope of works and service is indicated in the OFCI documents and in the SOR.

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2. EQUIPMENTS DESIGN DATA

2.1. CHILLER (OFCI)

Air cooled chiller SCREW with free-cooling module and glycol-free kit	
Redundancy	N+2
Number	12+2
Chiller capacity in failure operation N	1220 kW
Chiller capacity in normal operation N+2	1045 kW
Fluid	Water
Chilled water temperatures	23 / 33 °C
Ambient design summer air temperature	43 °C
Ambient design winter air temperature	-10 °C
Compressors type	Screw
Free-cooling	Yes, internal. Failure design capacity in free-cooling at min. 0 °C of ambient T
Accessories	Hydronic module with pump + acoustic package + harmonic filters + glycol free kit (glycol only in the free-cooling circuit)
Sound power limit daytime	94,6 dBA
Sound power limit nightime	90,6 dBA
Fans ESP	25 Pa
Pump ESP	350 kPa
Min. flow	15% of the design failure value
Power feeds	2, 1 main for chiller (400/3/50) and 1 for pump and control (400/3/50)
Power consumption in N	320 kW + 20 kW of pump
Length	13200 mm
Width	2300 mm
Height	2400 mm

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2.2. DH Fan Wall (OFCI)

Fan Wall with frontal flow	
Redundancy per DH	N+2
Number per DH	12+2
FW capacity in failure operation N	540 kW
FW capacity in normal operation N+2	463 kW
DH configuration	Hot-aisles with false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37,8 °C (10,8 max deltaT)
Air return	From the back through the mechanical corridor opened to the DH false-ceiling
Air supply	From the front
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	34 kW
Length	4400 mm
Width	1800 mm
Height	4000 mm

2.3. Critical powerblock LV1 pods and 1R LV1 pod CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	105 kW
CRAH capacity in normal operation N+1	53 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	7,6 kW
Length	2600 mm
Width	900 mm
Height (without return plenum)	2600 mm

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2.4. Critical powerblock LV2 pods CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	50 kW
CRAH capacity in normal operation N+1	25 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	2,1 kW
Length	1800 mm
Width	900 mm
Height (without return plenum)	2600 mm

2.5. 1R LV2 and 1H LV1 pods CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	25 kW
CRAH capacity in normal operation N+1	13 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	0,9 kW
Length	1200 mm
Width	900 mm
Height (without return plenum)	2000 mm

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2.6. CER CRAH

CRAH with downflow supply	
Redundancy per CER	N+1
Number per CER	1+1
CRAH capacity in failure operation N	40 kW
CRAH capacity in normal operation N+1	20 kW
CER configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	1,4 kW
Length	1800 mm
Width	900 mm
Height (without return plenum)	2000 mm

2.7. Electrical Corridor DX system

Monosplit DX system	
Redundancy per room	N+1
Number per room	3+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	8,3 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Ceiling mounted unit
Outdoor unit	Air cooled unit placed on the roof
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

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2.8. MMR DX system

Monosplit DX system	
Redundancy per room	N+1
Number per room	1+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	5 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature range	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Wall mounted unit
Outdoor unit	Air cooled unit placed on the roof
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

2.9. Battery DX system (OFCI)

Monosplit DX system	
Redundancy per room	N+1
Number per room	3+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	8,3 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Ceiling mounted unit
Outdoor unit	Air cooled unit placed on side of the container
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

2.10. CHW buffer tank

Squared buffer tank	
Riser redundancy	N+1
Riser number	2+1
Tanks for riser	2
Volume of each tank	35 mc
Type	Sqaured for outdoor installation (insulated)
Fluid	Water
Ambient temperature range	-10 / 38 °C

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2.11. DH DOAS

Outdoor DOAS unit	
Number per phase	2 (2+0)
Airflow	2 sizes: 3140 and 2950 mc/h
Ambient temperature range	-10 / 38 °C
Summer supply temperature	18 °C
Summer return temperature	28 °C
Summer supply humidity	9,5 g/kg
Winter supply temperature	18 °C
Winter return temperature	20 °C
Winter supply humidity	6,5 g/kg
Supply sections	Motorized damper + filter 1 + filter 2 + sound attenuator + recovery wheel + recirculation damper + dx coil + post-heating electric coil + RTS humidifier + fan + motorized damper
Return sections	Motorized damper + filter + fan + recirculation damper + recovery wheel + sound attenuator + motorized damper
Supply filters	M5 + F7
Return filter	M5
Fans ESP	Max. 350 Pa
Accessories	Outdoor dx unit + Humidifier + Skid to host every part of the unit + Insulated box to host humidifier
Power feeds	1 (400/3/50)
Power consumption in N	40 kW

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2.12. AF DOAS

Outdoor DOAS unit	
Number per phase	1 (1+0)
Airflow	5400 mc/h
Ambient temperature range	-4 / 33.8 °C
Summer supply temperature	23 °C
Summer return temperature	26 °C
Summer supply humidity	11 g/kg
Winter supply temperature	20 °C
Winter return temperature	20 °C
Winter supply humidity	6,5 g/kg
Supply sections	Motorized damper + filter 1 + filter 2 + sound attenuator + recovery wheel + dx heating/cooling coil + post-heating dx coil + post-heating electric coil + RTS humidifier + fan + motorized damper
Return sections	Motorized damper + filter + fan + recovery wheel + indirect adiabatic humidifier with condensate reuse + dx heating/cooling coil + sound attenuator + motorized damper
Supply filters	M5 + F7
Return filter	M5
Fans ESP	Max. 350 Pa
Accessories	Internal heat pump circuit + Humidifier + Skid to host every part of the unit + Insulated box to host humidifier
Power feeds	1 (400/3/50)
Power consumption in N	60 kW

2.13. Pressurization/Degassing unit

Unit with water pump control	
Number per phase	3 (2+1)
Redundancy	N+1
System volume to be controlled	150 mc
Hydrostatic height	14 m
Max temperature	40 °C
Min temperature	5 °C
Vessel size	3 mc
Pressure rating	10 bar
Accessories	Control panel + vacuum degasser + pump + vessel + refilling connection with fill set
Power feeds	1 (230/1/50)
Power consumption in N	1,5 kW

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2.14. Side stream filter

Skid with pump, filter and dosing pot	
Number per phase	2 (1+1)
Pump water flow	42 mc/h
Pump pressure head	17,5 m
Filter type	Bag filter 50µ with magnets
Pressure rating	10 bar
Material	Stainless steel
Accessories	Control panel + pump + pressure sensors + dosing pot + piping + butterfly valves + antivibration mounts
Power feeds	1 (400/3/50)
Power consumption	4 kW

2.15. Potable water booster pump

Booster set with two pumps	
Flowrate	8 mc/h
Pressure head	350 kPa
Power feeds	1 (400/3/50)
Power consumption	2 kW

2.16. Hot potable water heat pump

Booster set with two pumps	
Tank volume	240 l
Hot water temperature inside the boiler	60 °C
Accessories	Control panel + electric heater to reach 65°C
Power feeds	1 (400/3/50)
Power consumption	1 kW

2.17. Black sewage campus pump set

Automatic lifting station with two pumps	
Flowrate	18 mc/h
Pressure head	150 kPa
Redundancy	N+1 (1+1)
Accessories	Control panel + sound alarm + tank + sensors
Power feeds	1 (400/3/50)
Power consumption	1,5 kW

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- Fuel pump of the gensets and other mechanical/plumbing equiments installed inside the genset container

The scope of works and service is indicated in the OFCI documents and in the SOR.

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2. EQUIPMENTS DESIGN DATA

2.1. CHILLER (OFCI)

Air cooled chiller SCREW with free-cooling module and glycol-free kit	
Redundancy	N+2
Number	12+2
Chiller capacity in failure operation N	1220 kW
Chiller capacity in normal operation N+2	1045 kW
Fluid	Water
Chilled water temperatures	23 / 33 °C
Ambient design summer air temperature	43 °C
Ambient design winter air temperature	-10 °C
Compressors type	Screw
Free-cooling	Yes, internal. Failure design capacity in free-cooling at min. 0 °C of ambient T
Accessories	Hydronic module with pump + acoustic package + harmonic filters + glycol free kit (glycol only in the free-cooling circuit)
Sound power limit daytime	94,6 dBA
Sound power limit nightime	90,6 dBA
Fans ESP	25 Pa
Pump ESP	350 kPa
Min. flow	15% of the design failure value
Power feeds	2, 1 main for chiller (400/3/50) and 1 for pump and control (400/3/50)
Power consumption in N	320 kW + 20 kW of pump
Length	13200 mm
Width	2300 mm
Height	2400 mm

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2.2. DH Fan Wall (OFCI)

Fan Wall with frontal flow	
Redundancy per DH	N+2
Number per DH	12+2
FW capacity in failure operation N	540 kW
FW capacity in normal operation N+2	463 kW
DH configuration	Hot-aisles with false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37,8 °C (10,8 max deltaT)
Air return	From the back through the mechanical corridor opened to the DH false-ceiling
Air supply	From the front
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	34 kW
Length	4400 mm
Width	1800 mm
Height	4000 mm

2.3. Critical powerblock LV1 pods and 1R LV1 pod CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	105 kW
CRAH capacity in normal operation N+1	53 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	7,6 kW
Length	2600 mm
Width	900 mm
Height (without return plenum)	2600 mm

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2.4. Critical powerblock LV2 pods CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	50 kW
CRAH capacity in normal operation N+1	25 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	2,1 kW
Length	1800 mm
Width	900 mm
Height (without return plenum)	2600 mm

2.5. 1R LV2 and 1H LV1 pods CRAH (OFCI)

CRAH with downflow supply	
Redundancy per pod	N+1
Number per pod	2
CRAH capacity in failure operation N	25 kW
CRAH capacity in normal operation N+1	13 kW
Pod configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	0,9 kW
Length	1200 mm
Width	900 mm
Height (without return plenum)	2000 mm

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2.6. CER CRAH

CRAH with downflow supply	
Redundancy per CER	N+1
Number per CER	1+1
CRAH capacity in failure operation N	40 kW
CRAH capacity in normal operation N+1	20 kW
CER configuration	Without false-ceiling and without raised floor
Fluid	Water
Chilled water temperatures	23 / 33 °C
Air temperatures	27 / 37 °C
Air return	From the top with return plenum
Air supply	From the bottom-front with fan deck positioned below the coil
Accessories	Ultracapacitors or batteries to keep the control system alive during a power failure + PICV + ATS
Air filters	ePM1 20% / M5 filtration
Fans ESP	50 Pa
Power feeds	2 redundants with ATS (400/3/50)
Power consumption in N	1,4 kW
Length	1800 mm
Width	900 mm
Height (without return plenum)	2000 mm

2.7. Electrical Corridor DX system

Monosplit DX system	
Redundancy per room	N+1
Number per room	3+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	8,3 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Ceiling mounted unit
Outdoor unit	Air cooled unit placed on the roof
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

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2.8. MMR DX system

Monosplit DX system	
Redundancy per room	N+1
Number per room	1+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	5 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature range	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Wall mounted unit
Outdoor unit	Air cooled unit placed on the roof
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

2.9. Battery DX system (OFCI)

Monosplit DX system	
Redundancy per room	N+1
Number per room	3+1
DX capacity in failure operation N	10 kW
DX capacity in normal operation N+1	8,3 kW
Room configuration	Without false-ceiling and without raised floor
Ambient temperature	-10 / 38 °C
Indoor design temperature	25 °C
Indoor unit	Ceiling mounted unit
Outdoor unit	Air cooled unit placed on side of the container
Power feeds	1 (400/3/50)
Power consumption in N	3,5 kW

2.10. CHW buffer tank

Squared buffer tank	
Riser redundancy	N+1
Riser number	2+1
Tanks for riser	2
Volume of each tank	35 mc
Type	Sqaured for outdoor installation (insulated)
Fluid	Water
Ambient temperature range	-10 / 38 °C

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2.11. DH DOAS

Outdoor DOAS unit	
Number per phase	2 (2+0)
Airflow	2 sizes: 3140 and 2950 mc/h
Ambient temperature range	-10 / 38 °C
Summer supply temperature	18 °C
Summer return temperature	28 °C
Summer supply humidity	9,5 g/kg
Winter supply temperature	18 °C
Winter return temperature	20 °C
Winter supply humidity	6,5 g/kg
Supply sections	Motorized damper + filter 1 + filter 2 + sound attenuator + recovery wheel + recirculation damper + dx coil + post-heating electric coil + RTS humidifier + fan + motorized damper
Return sections	Motorized damper + filter + fan + recirculation damper + recovery wheel + sound attenuator + motorized damper
Supply filters	M5 + F7
Return filter	M5
Fans ESP	Max. 350 Pa
Accessories	Outdoor dx unit + Humidifier + Skid to host every part of the unit + Insulated box to host humidifier
Power feeds	1 (400/3/50)
Power consumption in N	40 kW

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2.12. AF DOAS

Outdoor DOAS unit	
Number per phase	1 (1+0)
Airflow	5400 mc/h
Ambient temperature range	-4 / 33.8 °C
Summer supply temperature	23 °C
Summer return temperature	26 °C
Summer supply humidity	11 g/kg
Winter supply temperature	20 °C
Winter return temperature	20 °C
Winter supply humidity	6,5 g/kg
Supply sections	Motorized damper + filter 1 + filter 2 + sound attenuator + recovery wheel + dx heating/cooling coil + post-heating dx coil + post-heating electric coil + RTS humidifier + fan + motorized damper
Return sections	Motorized damper + filter + fan + recovery wheel + indirect adiabatic humidifier with condensate reuse + dx heating/cooling coil + sound attenuator + motorized damper
Supply filters	M5 + F7
Return filter	M5
Fans ESP	Max. 350 Pa
Accessories	Internal heat pump circuit + Humidifier + Skid to host every part of the unit + Insulated box to host humidifier
Power feeds	1 (400/3/50)
Power consumption in N	60 kW

2.13. Pressurization/Degassing unit

Unit with water pump control	
Number per phase	3 (2+1)
Redundancy	N+1
System volume to be controlled	150 mc
Hydrostatic height	14 m
Max temperature	40 °C
Min temperature	5 °C
Vessel size	3 mc
Pressure rating	10 bar
Accessories	Control panel + vacuum degasser + pump + vessel + refilling connection with fill set
Power feeds	1 (230/1/50)
Power consumption in N	1,5 kW

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2.14. Side stream filter

Skid with pump, filter and dosing pot	
Number per phase	2 (1+1)
Pump water flow	42 mc/h
Pump pressure head	17,5 m
Filter type	Bag filter 50µ with magnets
Pressure rating	10 bar
Material	Stainless steel
Accessories	Control panel + pump + pressure sensors + dosing pot + piping + butterfly valves + antivibration mounts
Power feeds	1 (400/3/50)
Power consumption	4 kW

2.15. Potable water booster pump

Booster set with two pumps	
Flowrate	8 mc/h
Pressure head	350 kPa
Power feeds	1 (400/3/50)
Power consumption	2 kW

2.16. Hot potable water heat pump

Booster set with two pumps	
Tank volume	240 l
Hot water temperature inside the boiler	60 °C
Accessories	Control panel + electric heater to reach 65°C
Power feeds	1 (400/3/50)
Power consumption	1 kW

2.17. Black sewage campus pump set

Automatic lifting station with two pumps	
Flowrate	18 mc/h
Pressure head	150 kPa
Redundancy	N+1 (1+1)
Accessories	Control panel + sound alarm + tank + sensors
Power feeds	1 (400/3/50)
Power consumption	1,5 kW

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STACK INFRASTRUCTURE MIL07

Campus CFD Study

POI: S4 – Suitable for stage approvale

Reference: MIL07-DBA-EX-XX-CA-M-55040

Revision: P01

Date: 7th November 2025

Document title:	Calculation - CFD - Campus
Reference:	MIL07-DBA-EX-XX-CA-M-55040
Status:	S4/P01
Date:	7th November 2025
Project name:	STACK INFRASTRUCTURE MIL07
Project number:	13038001
Authors:	Marco Colombo / Luca Guarino
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Checked by:	Gaetano Russo
Date:	7th November 2025
Approved by:	Sacha Busetti
Date:	7th November 2025

Introduction

This report presents the results of the Computer Fluid Dynamic (CFD) simulations for the MIL07 campus. The study was conducted to evaluate the inlet temperatures of the chillers and generators during emergency generator operation, under the ASHRAE 20-year extreme temperature condition (38.0°C), with the chillers working in normal operation (N+2, cooling capacity 1045 kW) and in failure operation (N, cooling capacity 1220 kW).

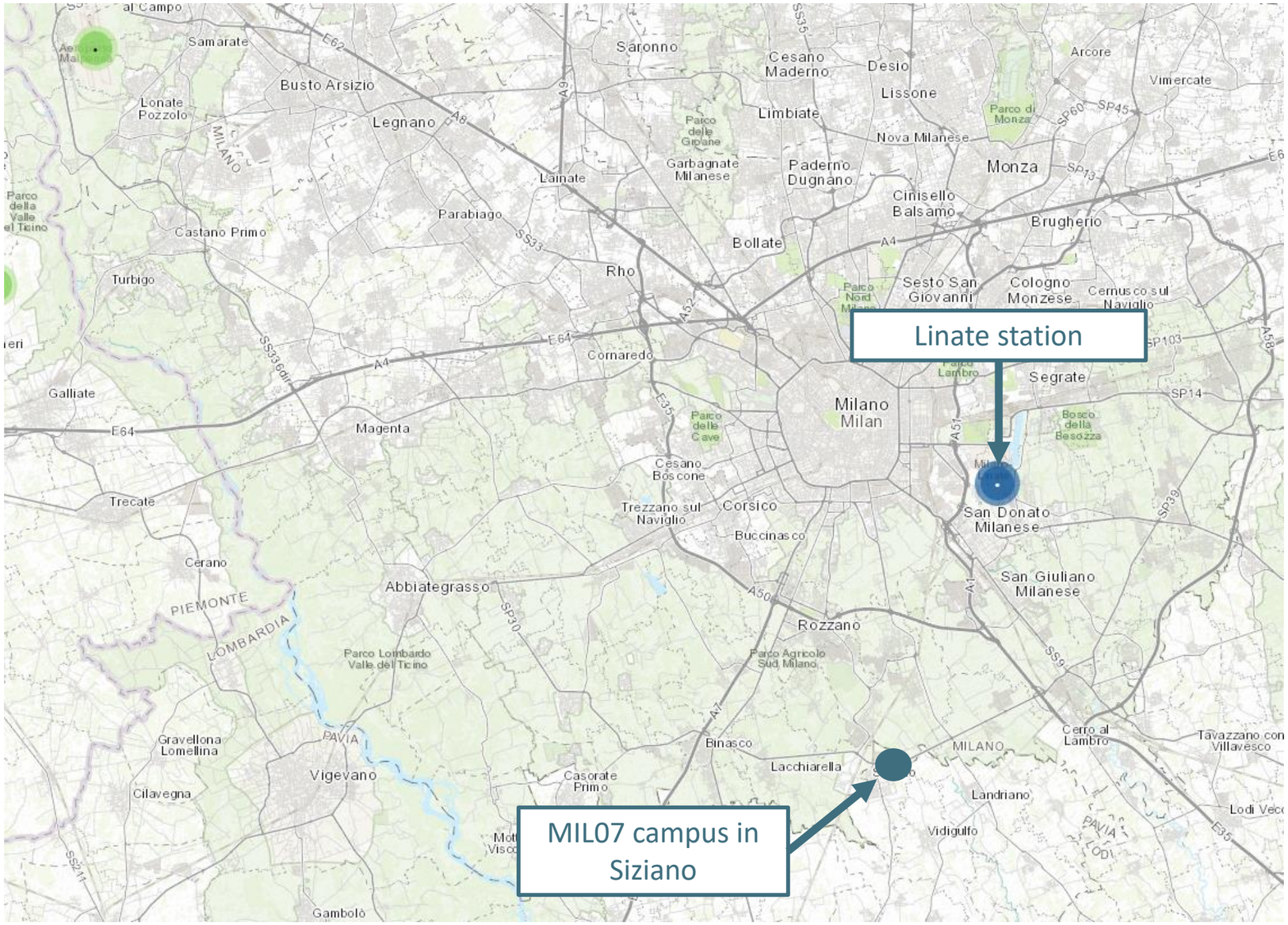
The goals are:

- Verify that the mean inlet temperatures of the chillers are below 43 °C (desing summer temperature);
- Verify that the mean inlet temperatures for the generators are below 40°C .
- Verify that the ESP of the chillers are below 25 Pa.

CFD software: Cadence Reality DC Design

Weather data

Siziano is located at the south of Milan, the nearest ASHRAE weather station is Milano Linate.



Weather data

ARPA (Agenzia Regionale per la Protezione dell'Ambiente) is an Italian environmental institution that provides weather data too. For the analysis, we considered ASHRAE data (Milano Linate) and compared them with ARPA ones since their weather station is closer to Siziano (is located in Lacchiarella).

Temperature data:

ARPA temperature data are affine to the temperature of the ASHRAE station of Milano Linate. So for maximum temperature, the Milano Linate extreme annual temperature at N=20 years will be considered.

Wind data:

ARPA data suggests that in the hottest hours (T>35°C), the most frequent winds come from the West, Southwest and South. These results are fairly consistent with the ASHRAE data of Milano Linate.

Regarding wind speed, ARPA data show that during the hottest hours (T>35°C), the maximum wind speed is always below 2.6 m/s that is the highest mean wind speed recorded at the ASHRAE station of Milan Linate. Therefore, in a conservative way, ASHRAE wind speed will be used for the simulations.

CFD Inputs

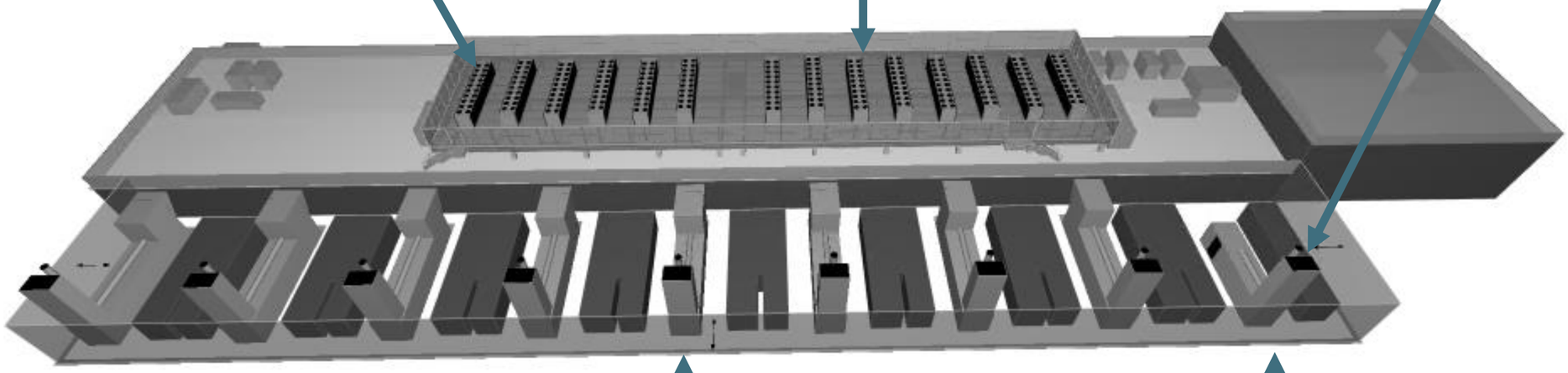
CFD Model

3D view from the CFD model.

8 chillers in phs 1 installed on a chiller platform.
6 chillers in phs 2 installed on a chiller platform.

Chiller platforms with:
80% perforated floor
80% perforated walls

5 chimneys in phs 1.
3 chimneys in phs 2.
1 chimney in phs XX (eventual phase 2 catcher).
All the chimneys installed closed to the vertical hood of the same generator.
All the chimneys with hot air outflows at +13,70 m from the basement of the generator



27% perforated wall

5 generators in phs 1.
3 generators in phs 2.
1 generator in phs XX (eventual phase 2 catcher).
All the generators with hot air outflows at +12,70 m from the basement of the generator

Ambient temperature

Maximum extreme annual temperature N=20 years: **38,0°C** (from ASHRAE 2025 Milano Linate weather Station)

MILANO LINATE, Italy — WMO: 160800

Lat: 45.445N | Lon: 9.277E | Elev: 108 | StdP: 100.04 | Time Zone: 1.00 (EUC) | Period: 1999-2023 | Grade: A | WBAN: 99999

Annual Heating, Humidification, and Ventilation Design Conditions

	Coldest Month	Heating DB		Humidification DP/MCDB and HR						Coldest Month WS/MCDB				MCWS/PCWD to 99.6% DB		WSF	
				99.6%			99%			0.4%		1%					
		99.6%	99%	DP	HR	MCDB	DP	HR	MCDB	WS	MCDB	WS	MCDB	MCWS	PCWD		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(1)	1	-4.0	-2.6	-11.3	1.4	5.0	-8.7	1.8	4.0	8.1	10.7	6.2	9.2	0.7	210	0.384	(1)

Annual Cooling, Dehumidification, and Enthalpy Design Conditions

	Hottest Month	Hottest Month DB Range	Cooling DB/MCWB						Evaporation WB/MCDB						MCWS/PCWD to 0.4% DB		
			0.4%		1%		2%		0.4%		1%		2%				
			DB	MCWB	DB	MCWB	DB	MCWB	WB	MCDB	WB	MCDB	WB	MCDB	MCWS	PCWD	
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(2)	7	10.5	33.8	23.6	32.5	22.8	31.3	22.1	25.1	31.2	24.1	30.2	23.2	29.3	2.1	220	(2)

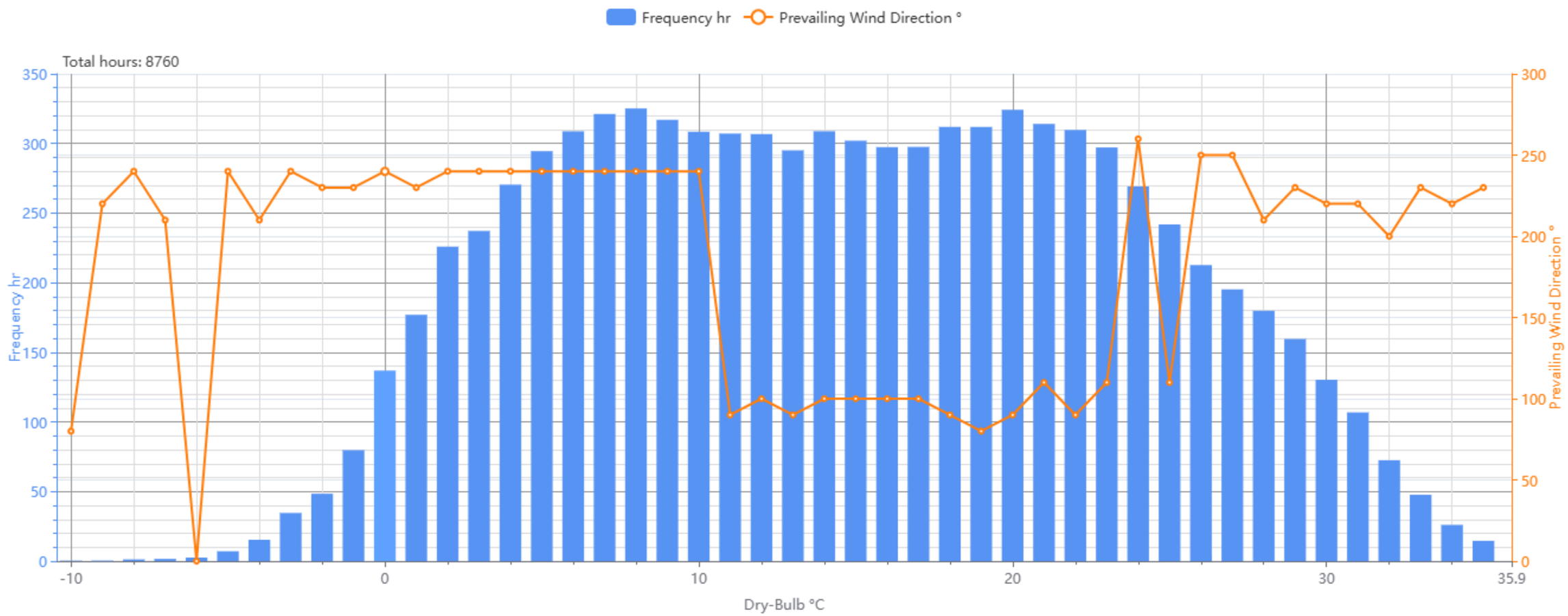
	Dehumidification DP/MCDB and HR									Enthalpy/MCDB						Extreme Max WB	
	0.4%			1%			2%			0.4%		1%		2%			
	DP	HR	MCDB	DP	HR	MCDB	DP	HR	MCDB	Enth	MCDB	Enth	MCDB	Enth	MCDB		
	(a)	(b)	(c)	(d)	(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)	
(3)	23.2	18.2	28.7	22.1	17.0	27.4	21.2	16.0	26.6	76.7	31.0	72.4	30.1	68.9	29.2	29.0	(3)

Extreme Annual Design Conditions

	Extreme Annual WS				Extreme Annual Temperature				n-Year Return Period Values of Extreme Temperature									
					Mean		Standard Deviation		n=5 years		n=10 years		n=20 years		n=50 years			
	1%	2.5%	5%		Min	Max	Min	Max	Min	Max	Min	Max	Min	Max	Min	Max		
	(a)	(b)	(c)		(e)	(f)	(g)	(h)	(i)	(j)	(k)	(l)	(m)	(n)	(o)	(p)		
(4)	6.3	4.9	4.1	DB	-6.3	35.7	2.0	1.2	-7.8	36.6	-9.0	37.3	-10.1	38.0	-11.6	38.8	(4)	
(5)				WB	-7.0	25.9	2.1	1.4	-8.5	26.9	-9.8	27.7	-10.9	28.5	-12.5	29.5	(5)	

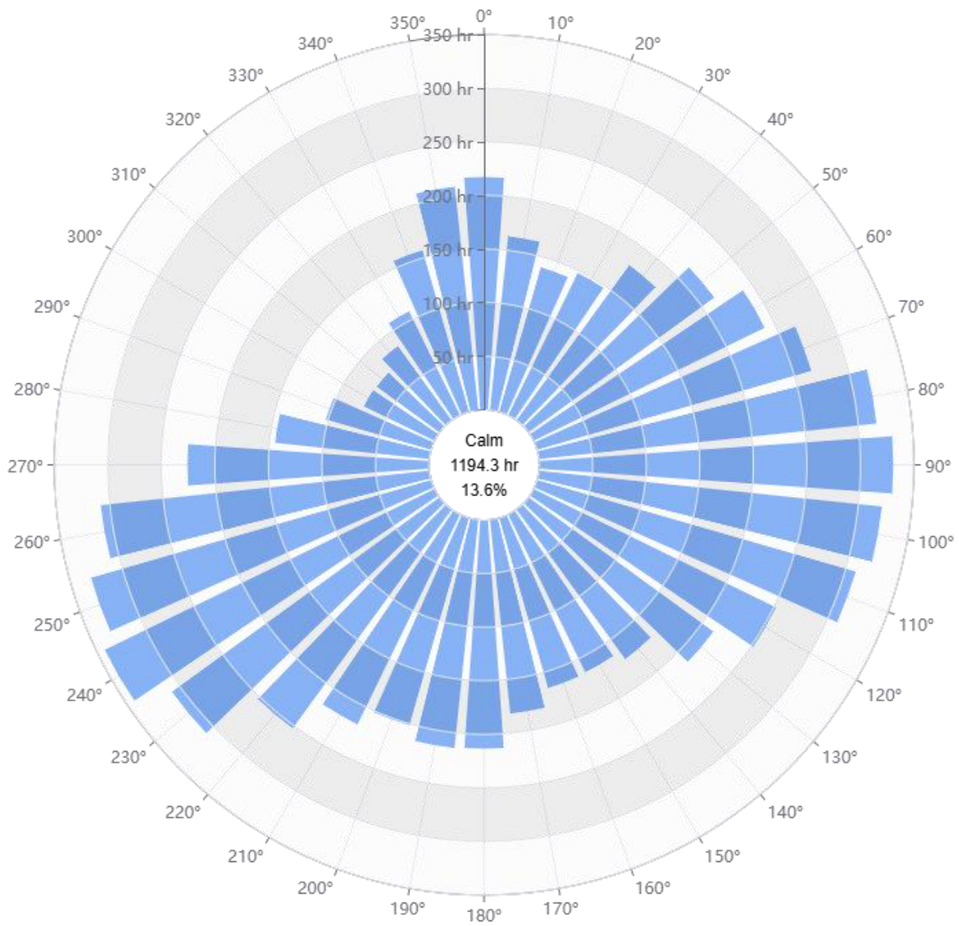
Wind direction

Wind direction plot from ASHRAE 2025 Milano Linate weather data.
Above 25°C the prevailing wind direction varies from 200° to 250° (South-West wind), with temperatures below 25°C the most frequent wind is from East (80° to 110°)
So for the analysis the two wind directions chosen are **230°** and **110°.**



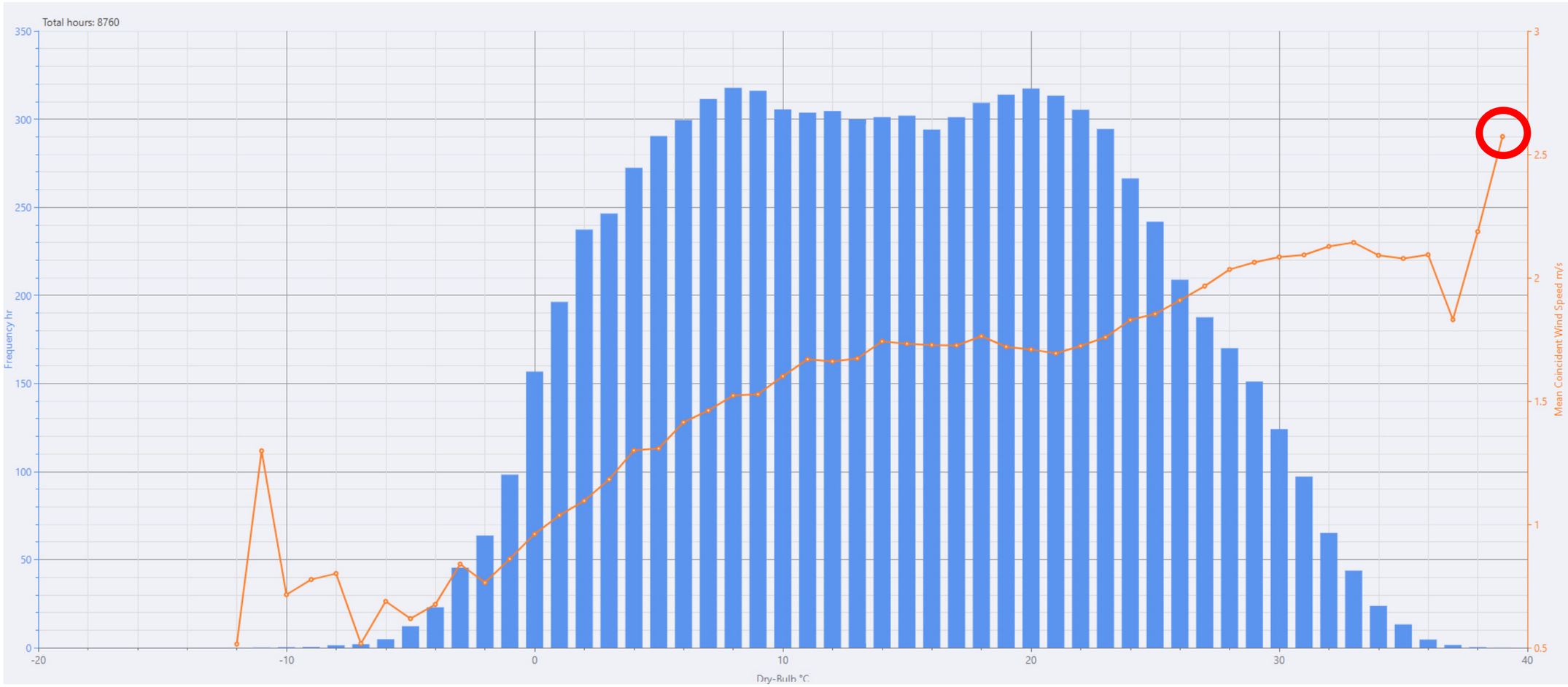
Wind direction

Wind direction rose from ASHRAE 2025 Milano Linate weather data.
The most frequent annual wind directions are East and Southwest. These directions are consistent with the 230° and 110° wind directions used for the analysis.



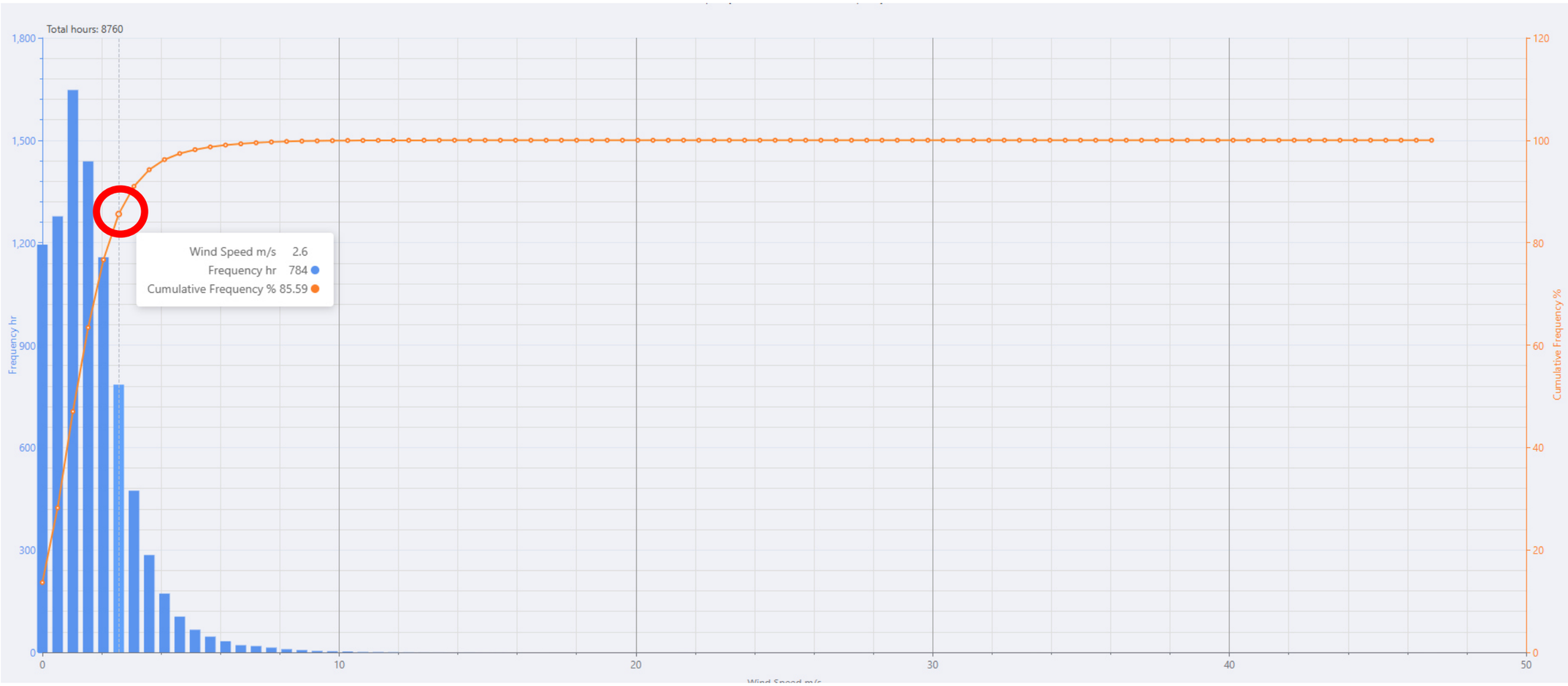
Wind speed

Wind speed plot from ASHRAE 2025 Milano Linate weather data.
During hot hours (T>35°C) the hightest mean wind speed registered is around 2,6 m/s.



Wind speed

Moreover, more then 85% of the wind speeds registered in Milano Linate ASHRAE station are lower then 2,6 m/s.
So for the analysis a wind speed of **2,6 m/s** has been considered.



Chiller specification

The chiller selected for WS3 is a Carrier unit , model 30XF-Z1700.

- Cooling capacity in normal mode (14 chillers running, N+2): 1045 kW
- Airflow in normal mode: 83,9 mc/s
- Estimated outlet temperature in normal mode: 51,9°C
- Cooling capacity in failure mode (12 chillers running, N): 1220 kW
- Airflow in failure mode: 88,5 mc/s
- Estimated outlet temperature in failure mode: 53,6°C
- Maximum design air inlet temperature: 43°C

30XF-Z 1700-

Variable Speed Air Cooled Chiller for Data Centers

Performance Information(2)			
Mode		**Cooling**	**Free Cooling**
Cooling Capacity (1)	kW	1220	1038
Cooling Efficiency (EER)(COP^{R})(1)	kW/kW	3.815	12.11
Unit Power Input (1)	kW	319.8	85.70
Sound power level (LwA) (1)	dB(A)	102.5	100.5
Sound Pressure Level at 10.0m (LpA)(1)	dB(A)	69.5	67.5
Minimum Capacity (3)	kW	170.0	-
Maximum Capacity	kW	1553	-

Generator specification

The generators selected for WS3 are from CAT. All the generators , excluded LLG-1H, have a power of 3000 kW.
Generator LLG-1H have a power of 1000 kW.

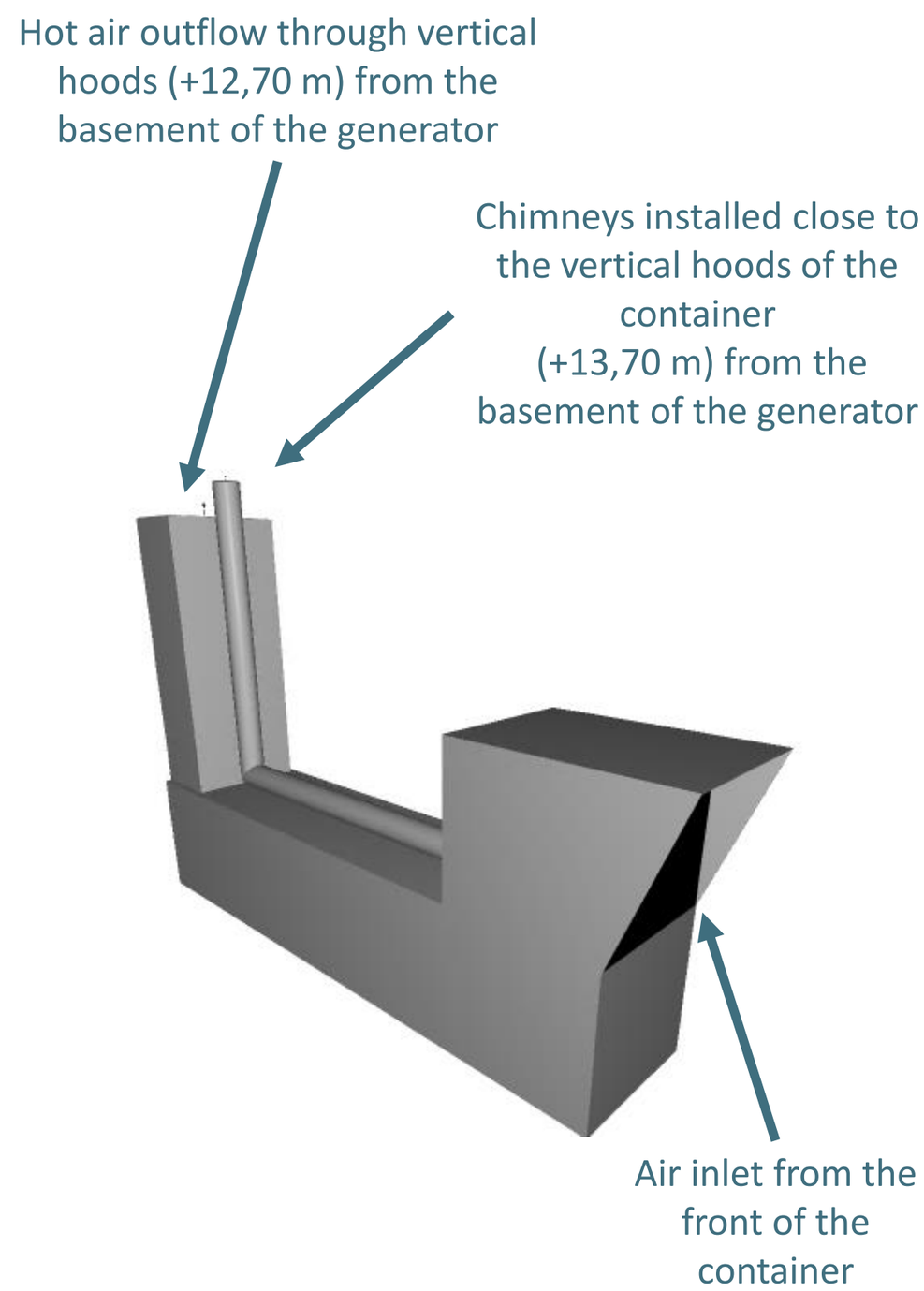
Data of the generators with power of 3000 kW:

Generator:

- Hot air airflow: 64 mc/s
- Hot air temperature: 78,0°C
- Inlet airflow: 69,1 mc/s

Chimney :

- Outlet airflow: 704,6 mc/min
- Outlet temperature: 460,7 °C



Generator specification

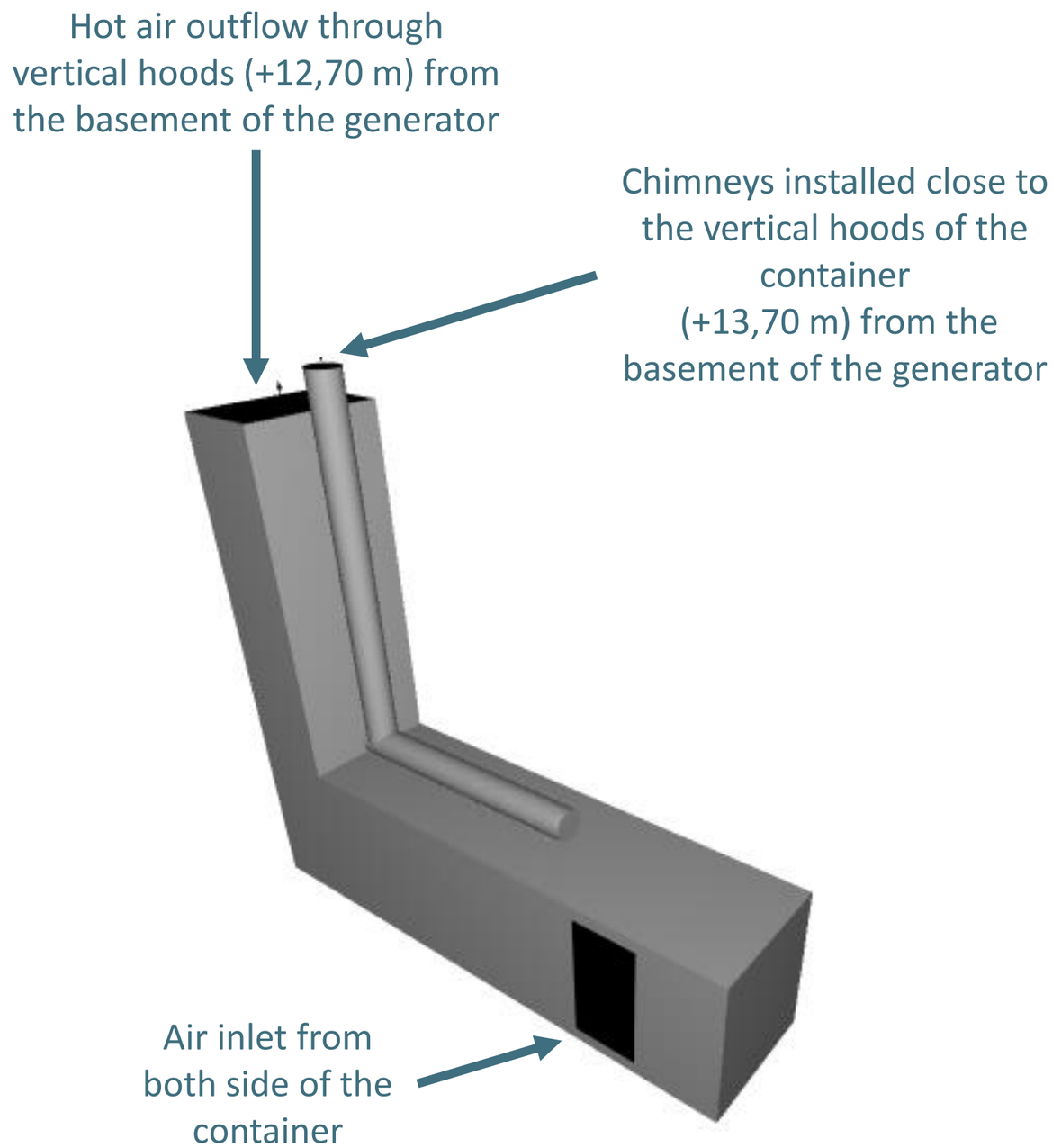
Data of generator with 1000 kW (Generator LLG-1H):

Generator :

- Hot air airflow: 18 mc/s
- Hot air temperature: 84,0°C
- Inlet airflow: 20,6 mc/s

Chimney :

- Outlet airflow: 428 mc/min
- Outlet temperature: 510,2 °C



Cases evaluated

The worst-case scenario occurs with a wind direction of 230° and an external temperature of 38°C. However, as indicated in the previous slide, at lower temperatures it is also common to have wind coming from 110°. Therefore, in a conservative way , two wind directions have been evaluated, both assuming the maximum external temperature of 38°C.

Case 1:

- Chillers working in normal operation (N+2)
- Outdoor temperature: 38 °C
- Wind direction: 230°
- Wind speed: 2,6 m/s
- Generators: ON

Case 2:

- Chillers working in normal operation (N+2)
- Outdoor temperature: 38 °C
- Wind direction: 110°
- Wind speed: 2,6 m/s
- Generators: ON

Cases evaluated

An additional simulation have be evaluated considering chillers operating in failure mode (N) under the worst weather conditions, with an outdoor temperature of 38°C, a wind direction 230° and a wind speed of 2,6 m/s. The chiller considered in failure are those with the lowest mean inlet temperature relevateed in Case 1.

Case 3:

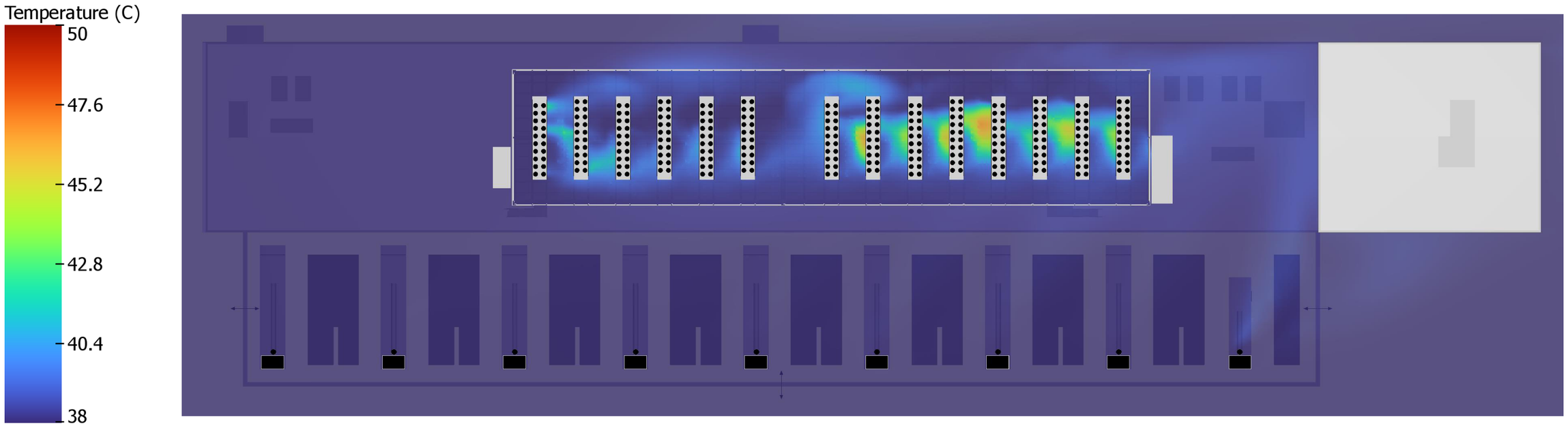
- Chillers working in failure operation (N). Fail of chillers CHL-11 and CHL-14.
- Outdoor temperature: 38 °C
- Wind direction: 230°
- Wind speed: 2,6 m/s
- Generators: ON

Results – Case 1 (38°C, wind 230°, chiller in N+2)

Air temperature at the chillers inlets

The image below shows the temperature plot at the chillers inlets.

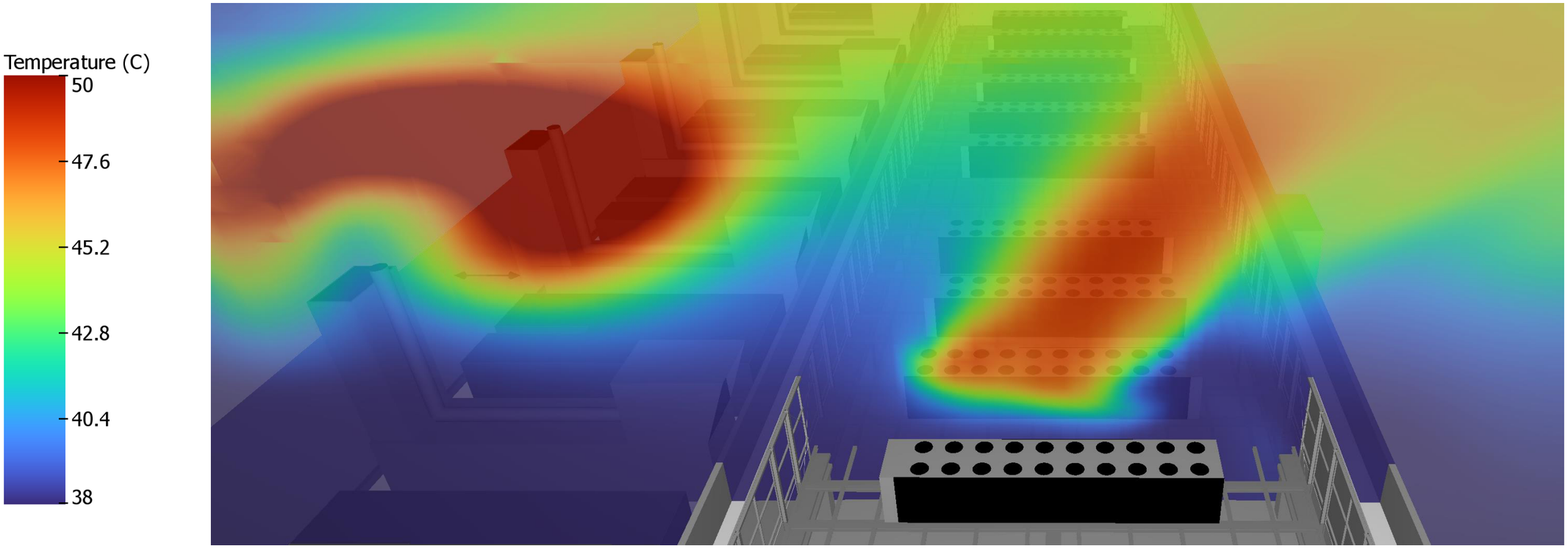
Due to air recirculation between the units, the inlet temperature of the chillers is always higher than the external ambient temperature.



Air temperature at the chiller inlets

The image below shows a section view of the space between two chillers.

The inlet temperatures of the chillers are not affected by the generators and chimneys air outlets.

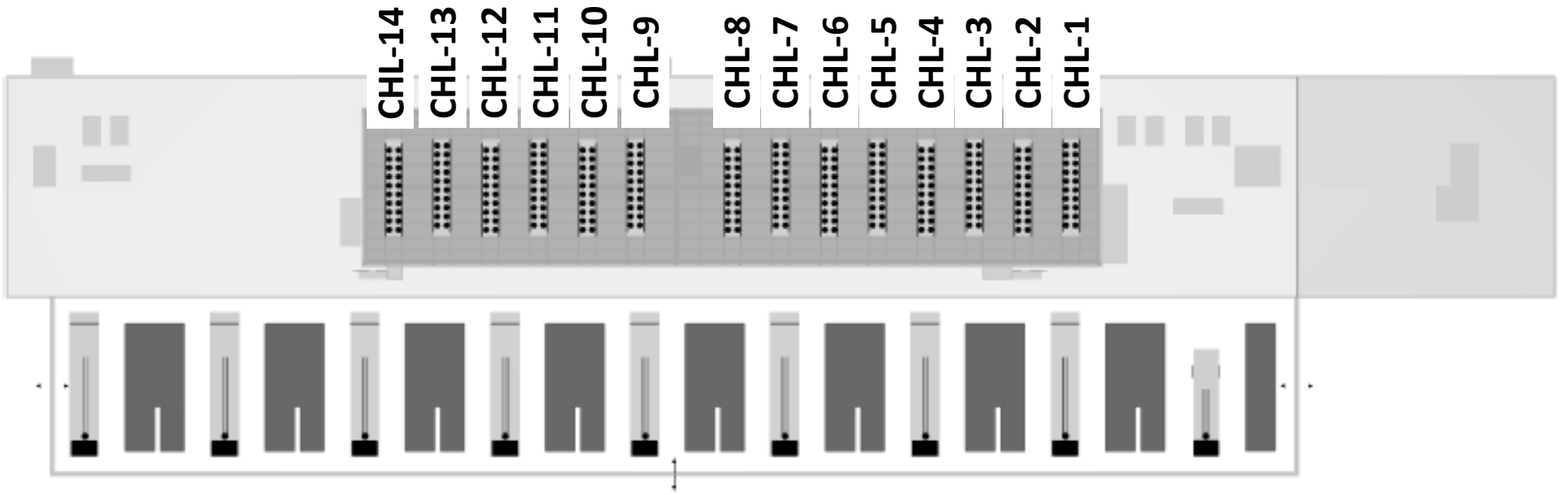


Air temperature at the chillers inlets

Chiller with inlet T under 43 °C

Chiller with inlet T over 43 °C

Chiller	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
CHL-1	39.3	43	-3.7
CHL-2	40.1	43	-2.9
CHL-3	39.8	43	-3.2
CHL-4	40.5	43	-2.5
CHL-5	40.3	43	-2.7
CHL-6	39.6	43	-3.4
CHL-7	40.1	43	-2.9
CHL-8	39.3	43	-3.7
CHL-9	38.6	43	-4.4
CHL-10	38.6	43	-4.4
CHL-11	38.5	43	-4.5
CHL-12	38.9	43	-4.1
CHL-13	39.3	43	-3.7
CHL-14	38.5	43	-4.5

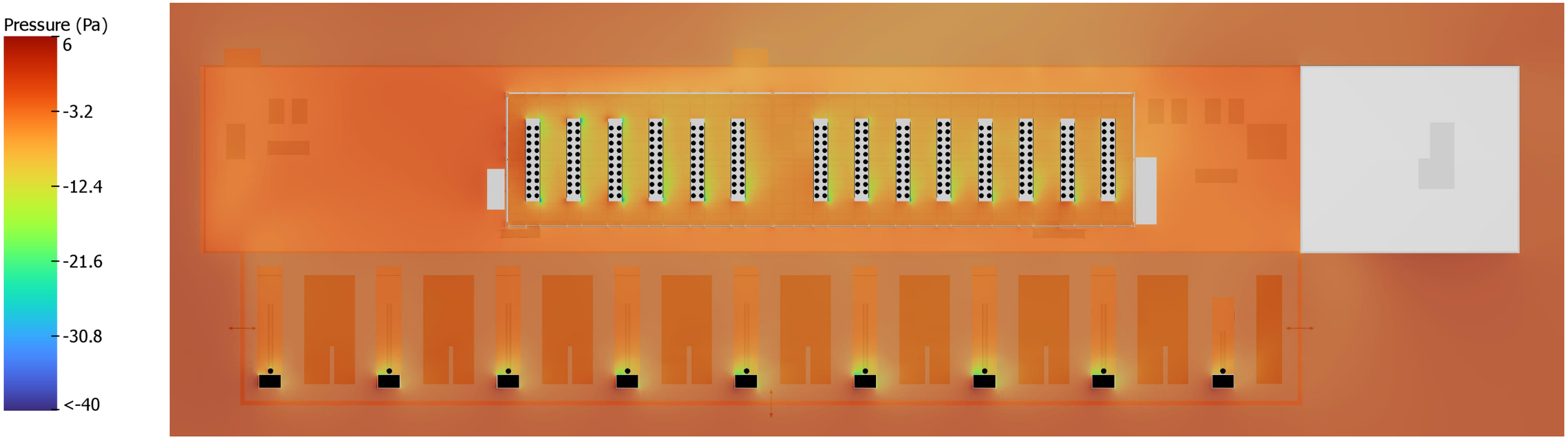


All the chillers have the air inlet temperature below the 43°C.

Air pressure at the chillers inlets

The image below shows the pressure plot at the chillers air inlets.

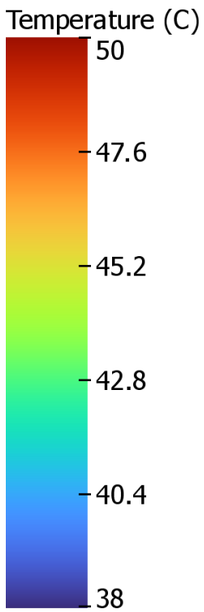
The mean ESP of the chillers is 8,2 Pa, while the maximum ESP is 8,8 Pa.

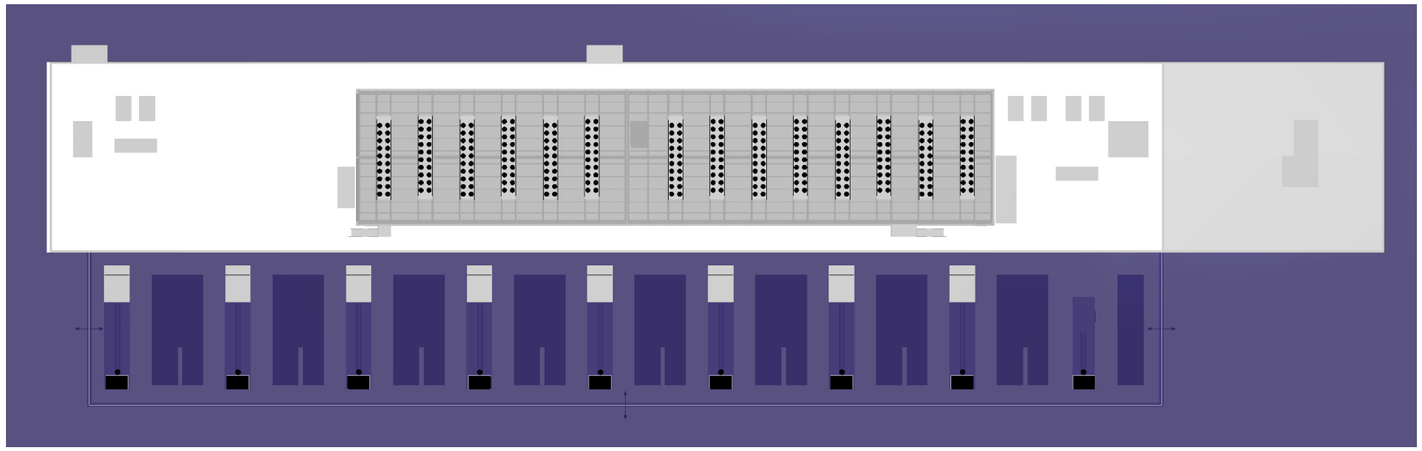


Air temperature at the generators inlets

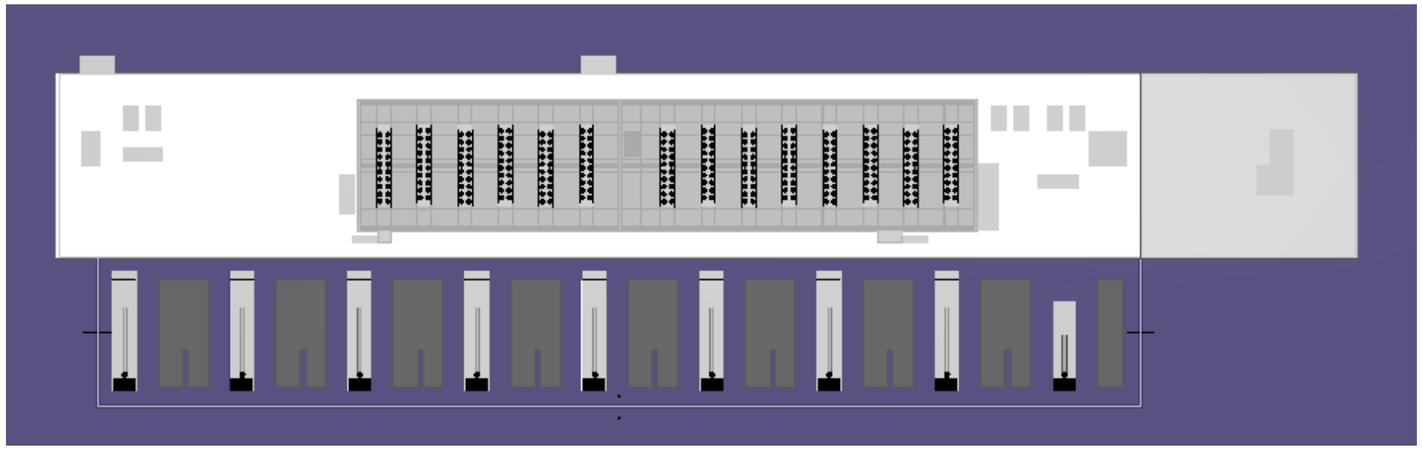
The images below shows the temperature plot at the generators inlets.

The inlet temperature of the generators is equal to the external ambient temperature.





Temperature plot the air inlets of all the generators excluded generator LLG-1H

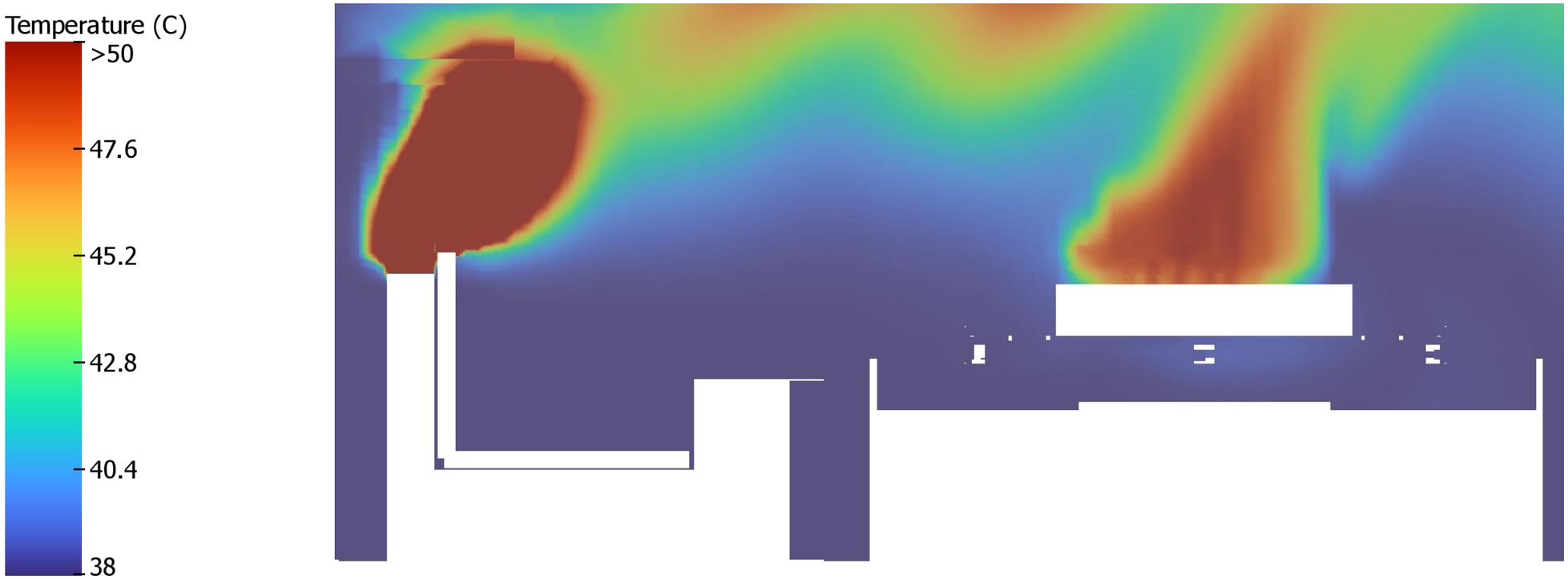


Temperature plot at the air inlet of generator LLG-1H

Air temperature at the generators inlets

The images below show a section view of the temperatures in correspondence of the air inlet of a generator.

The inlet temperatures of the generators are not affected by the air outlets of the chimneys, generators and chillers.

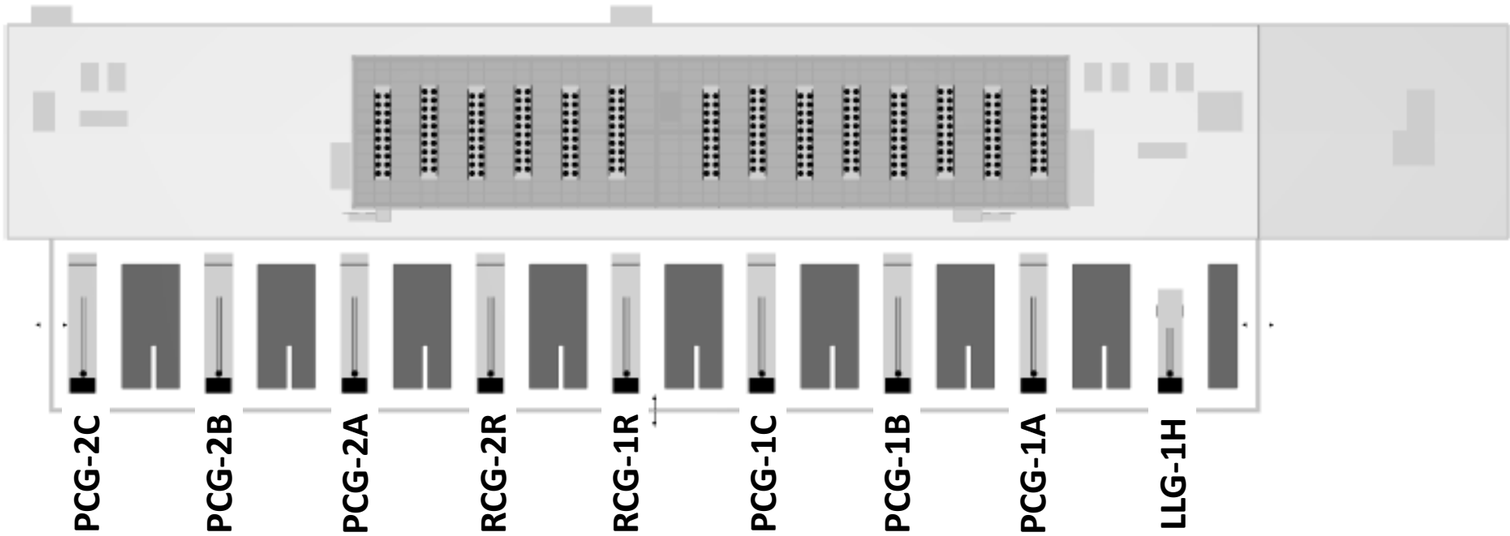


Air temperature at the generators inlets

Generator with inlet T under 40 °C

Generator with inlet T over 40 °C

Generator	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
LLG-1H	38.0	40.0	-2.0
PCG-1A	38.0	40.0	-2.0
PCG-1B	38.0	40.0	-2.0
PCG-1C	38.0	40.0	-2.0
RCG-1R	38.0	40.0	-2.0
PCG-2R	38.0	40.0	-2.0
PCG-2A	38.0	40.0	-2.0
PCG-2B	38.0	40.0	-2.0
PCG-2C	38.0	40.0	-2.0

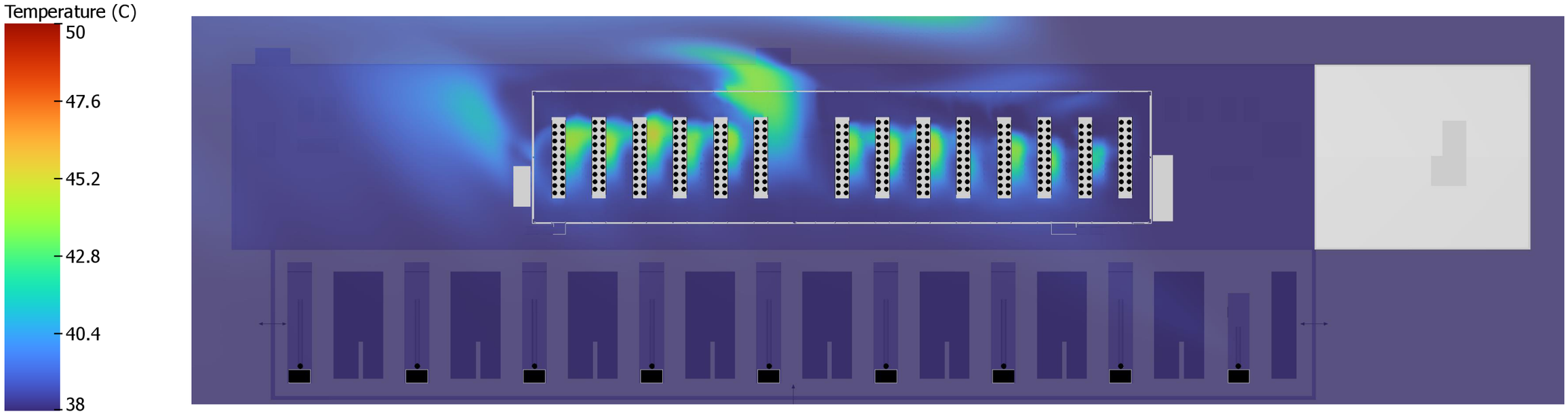


The inlet temperature of the generators is equal to the external ambient temperature.

Results – Case 2 (38°C, wind 110°, chiller in N+2)

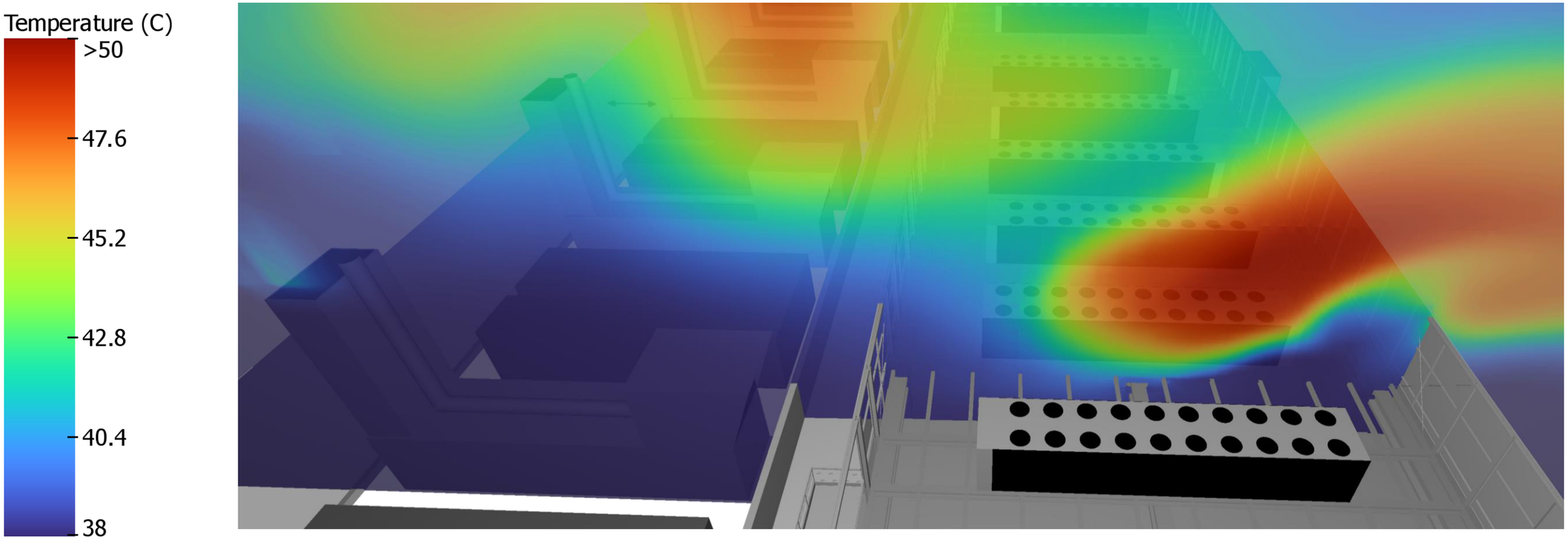
Air temperature at the chillers inlets

The image below shows the temperature plot at the chillers inlets.
Due to air recirculation between the units, the inlet temperature of the chillers is always higher than the external ambient temperature.



Air temperature at the chiller inlets

The image below shows a section view of the space between two chillers. The inlet temperatures of the chillers are not affected by the generators and chimneys air outlets.

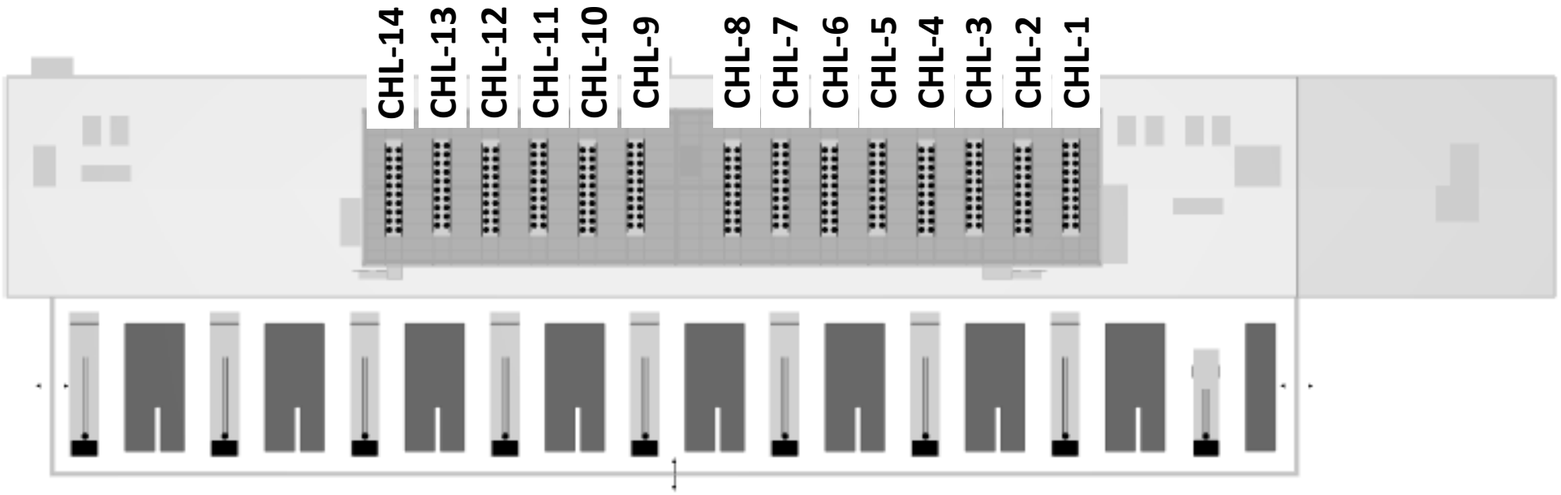


Air temperature at the chillers inlets

Chiller with inlet T under 43 °C

Chiller with inlet T over 43 °C

Chiller	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
CHL-1	38.5	43	-4.5
CHL-2	39.7	43	-3.3
CHL-3	40.4	43	-2.6
CHL-4	40.5	43	-2.5
CHL-5	40.1	43	-2.9
CHL-6	40.9	43	-2.1
CHL-7	40.9	43	-2.1
CHL-8	39.9	43	-3.1
CHL-9	40.1	43	-2.9
CHL-10	40.7	43	-2.3
CHL-11	41.0	43	-2.0
CHL-12	40.7	43	-2.3
CHL-13	41.0	43	-2.0
CHL-14	40.6	43	-2.4

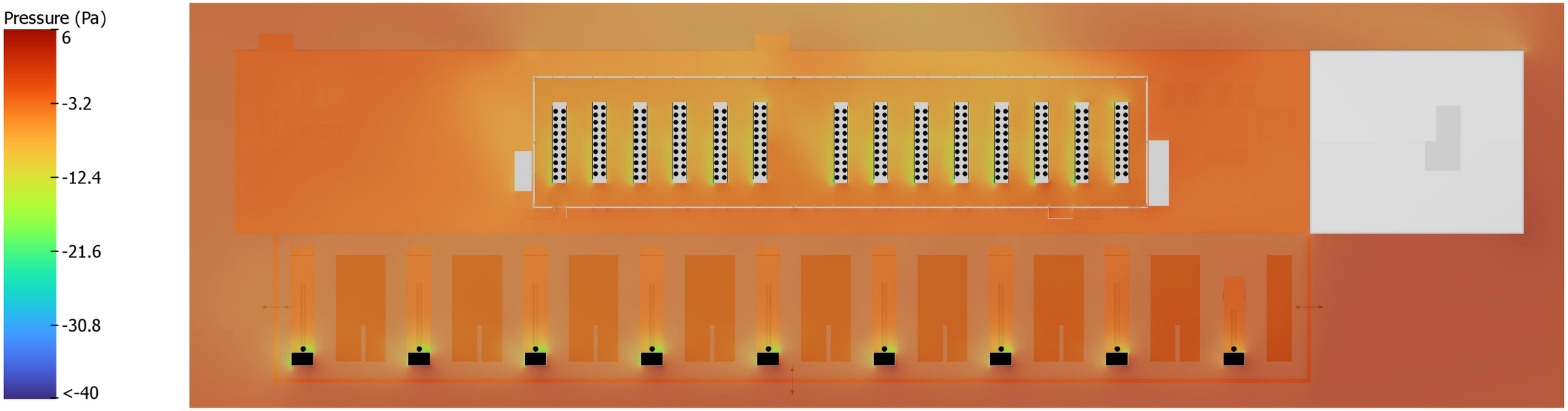


All the chillers have the air inlet temperature below the 43°C.

Air pressure at the chillers inlets

The image below shows the pressure plot at the chillers air inlets.

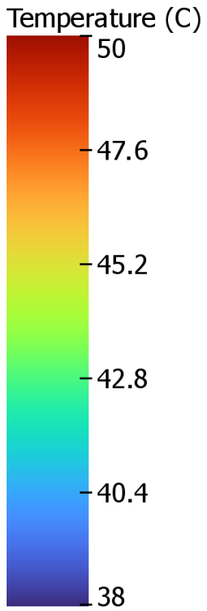
The mean ESP of the chillers is 8,7 Pa, while the maximum ESP is 9,5 Pa.

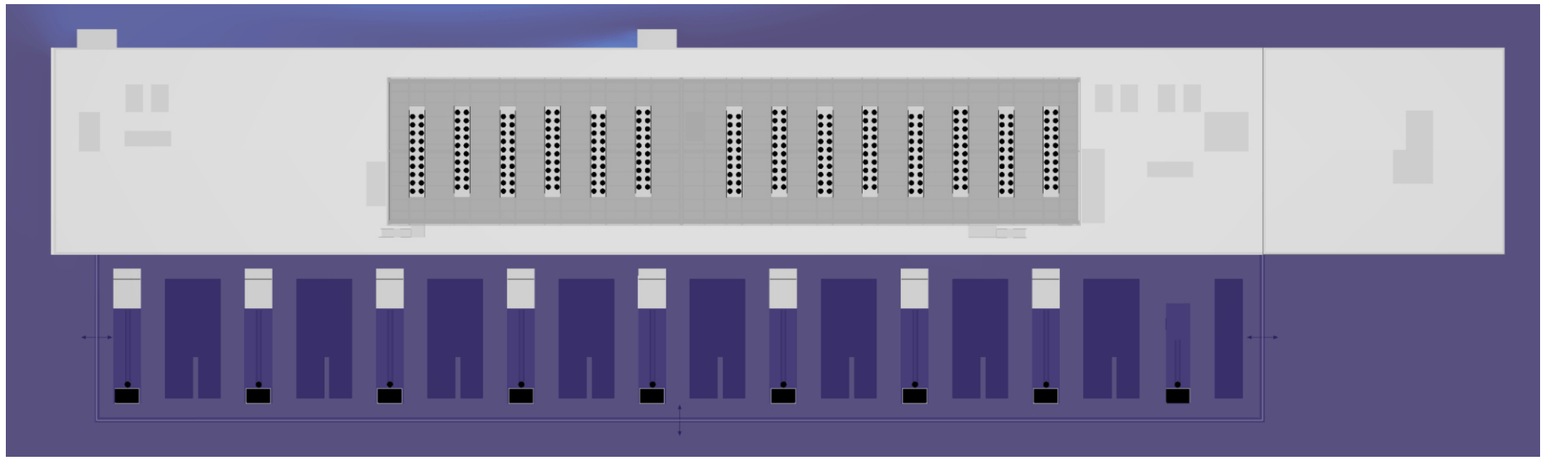


Air temperature at the generators inlets

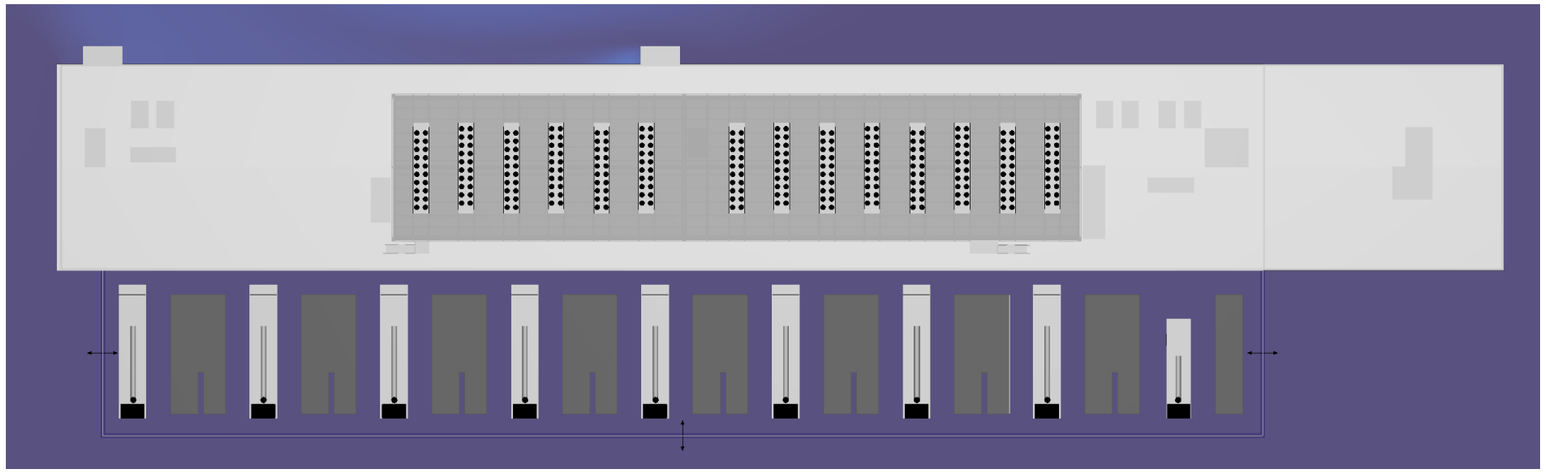
The image below shows the temperature plot at the generators inlets.

The inlet temperature of all the generators is equal to the external ambient temperature.





Temperature plot the air inlets of all the generators excluded generator LLG-1H

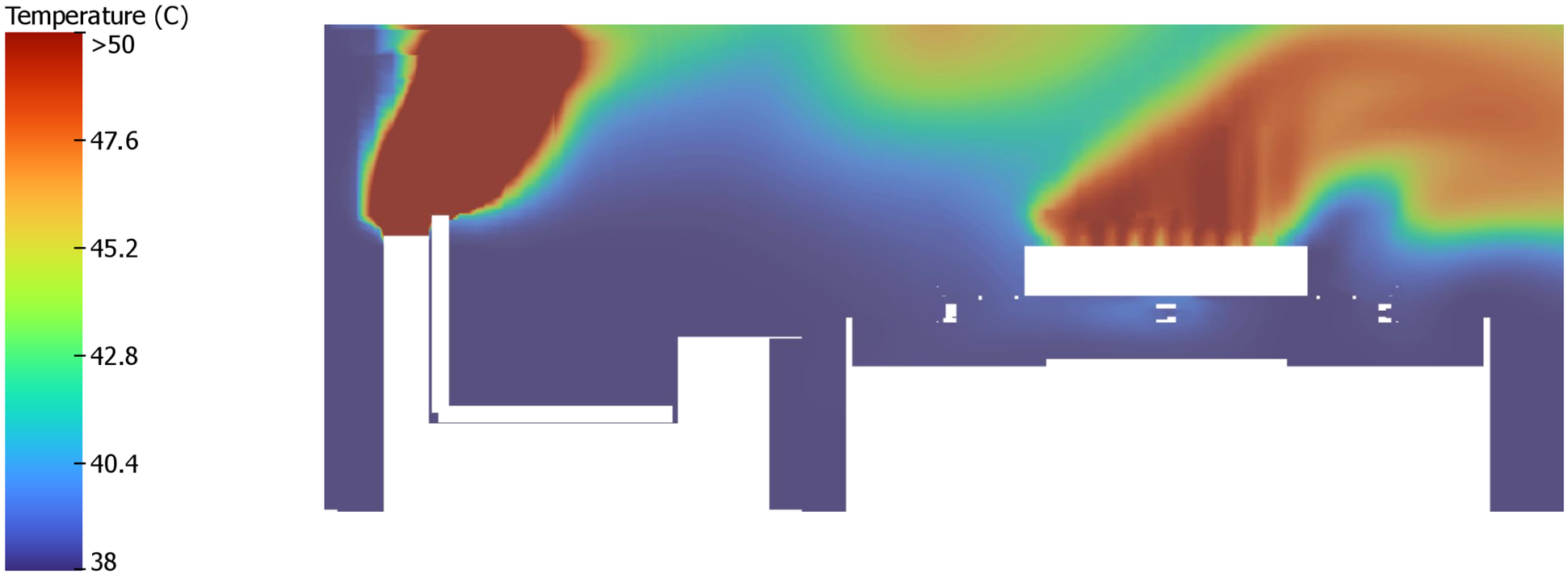


Temperature plot at the air inlet of generator LLG-1H

Air temperature at the generators inlets

The images below show a section view of the temperatures in correspondence of the air inlet of a generator.

The inlet temperatures of the generators are not affected by the air outlets of the chimneys, generators and chillers.

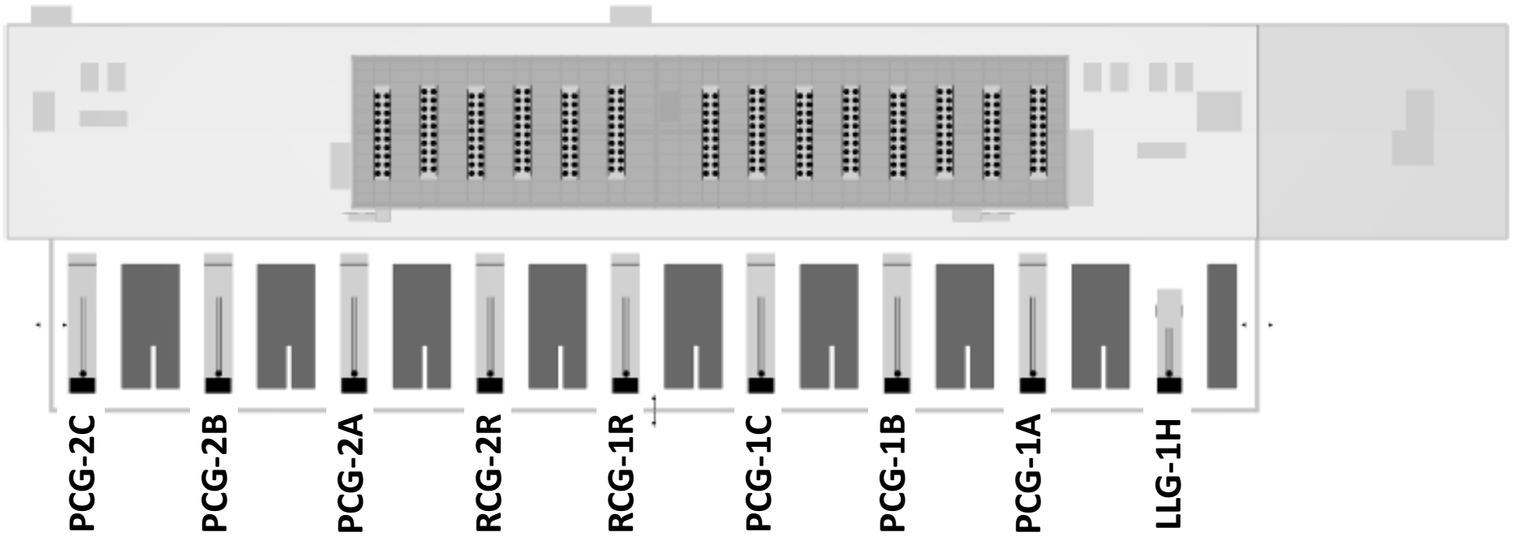


Air temperature at the generators inlets

Generator with inlet T under 40 °C

Generator with inlet T over 40 °C

Generator	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
LLG-1H	38.0	40.0	-2.0
PCG-1A	38.0	40.0	-2.0
PCG-1B	38.0	40.0	-2.0
PCG-1C	38.0	40.0	-2.0
RCG-1R	38.0	40.0	-2.0
PCG-2R	38.0	40.0	-2.0
PCG-2A	38.0	40.0	-2.0
PCG-2B	38.0	40.0	-2.0
PCG-2C	38.0	40.0	-2.0

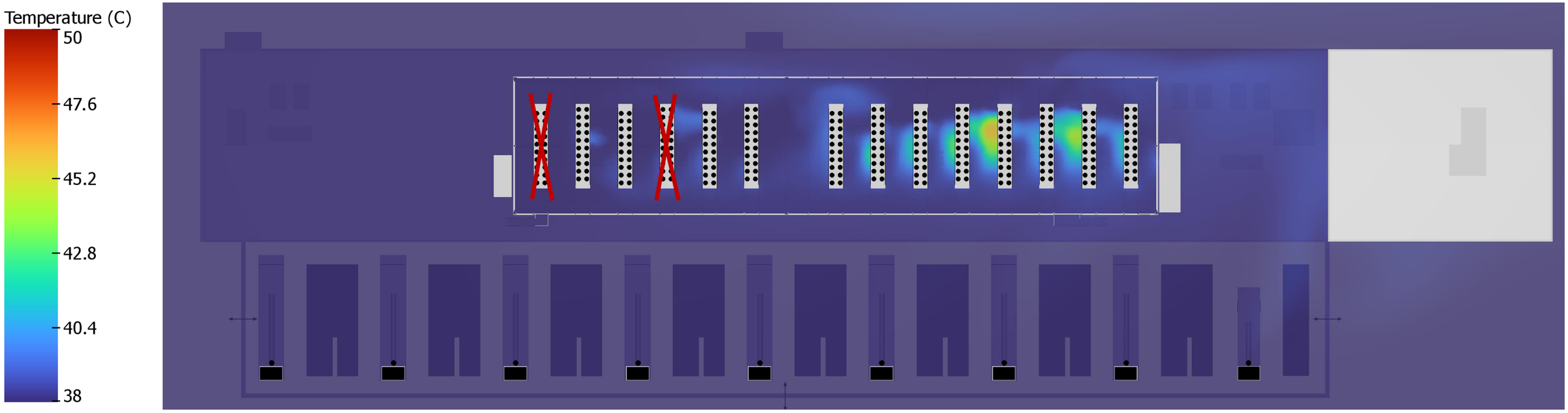


The inlet temperature of the generators is equal to the external ambient temperature.

Results – Case 3 (38°C, wind 230°, chiller in N with the fail of CHL-11 and CHL-14)

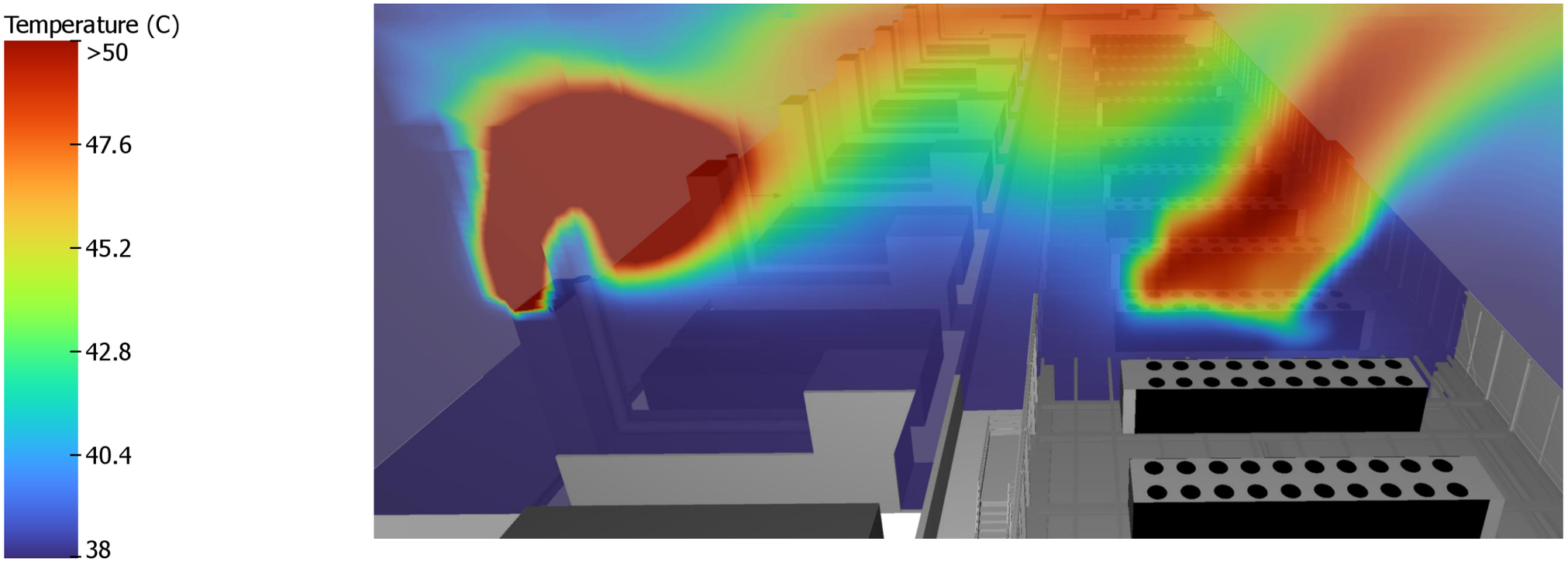
Air temperature at the chillers inlets

The image below shows the temperature plot at the chillers inlets.
Due to air recirculation between the units, the inlet temperature of the chillers is always higher than the external ambient temperature.



Air temperature at the chiller inlets

The image below shows a section view of the space between two chillers. The inlet temperatures of the chillers are not affected by the generators and chimneys air outlets.

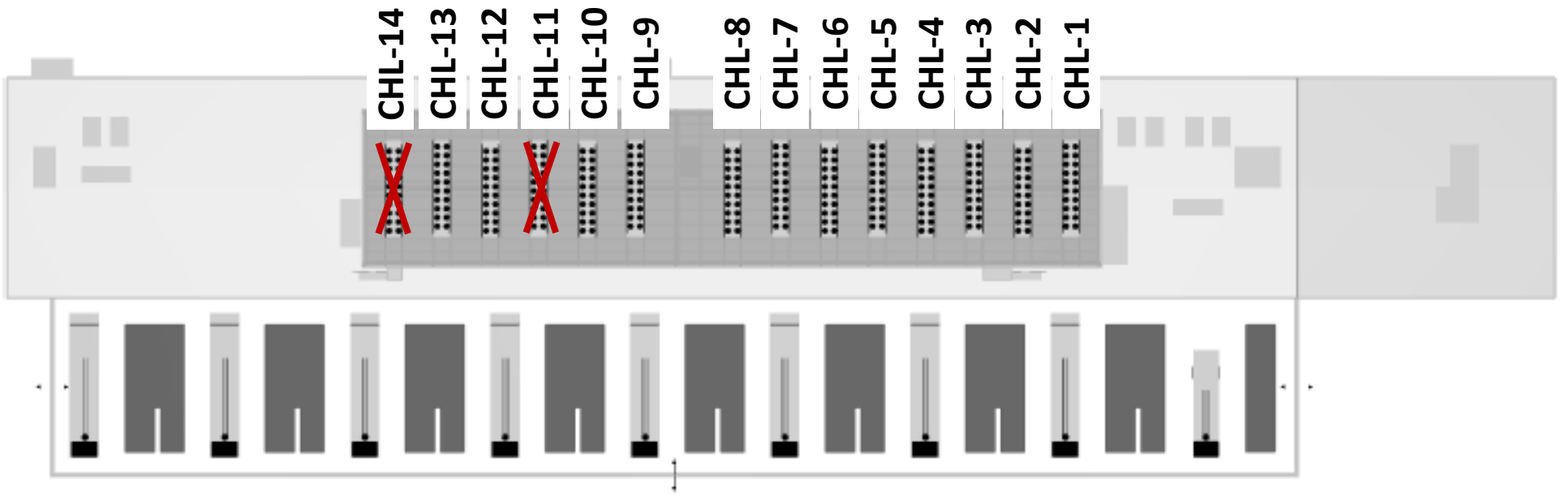


Air temperature at the chillers inlets

Chiller with inlet T under 43 °C

Chiller with inlet T over 43 °C

Chiller	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
CHL-1	39.3	43	-3.7
CHL-2	40.1	43	-2.9
CHL-3	39.8	43	-3.2
CHL-4	40.6	43	-2.4
CHL-5	40.4	43	-2.6
CHL-6	39.7	43	-3.3
CHL-7	39.8	43	-3.2
CHL-8	39.0	43	-4.0
CHL-9	38.4	43	-4.6
CHL-10	38.6	43	-4.4
CHL-11	-	-	-
CHL-12	38.6	43	-4.4
CHL-13	38.7	43	-4.3
CHL-14	-	-	-

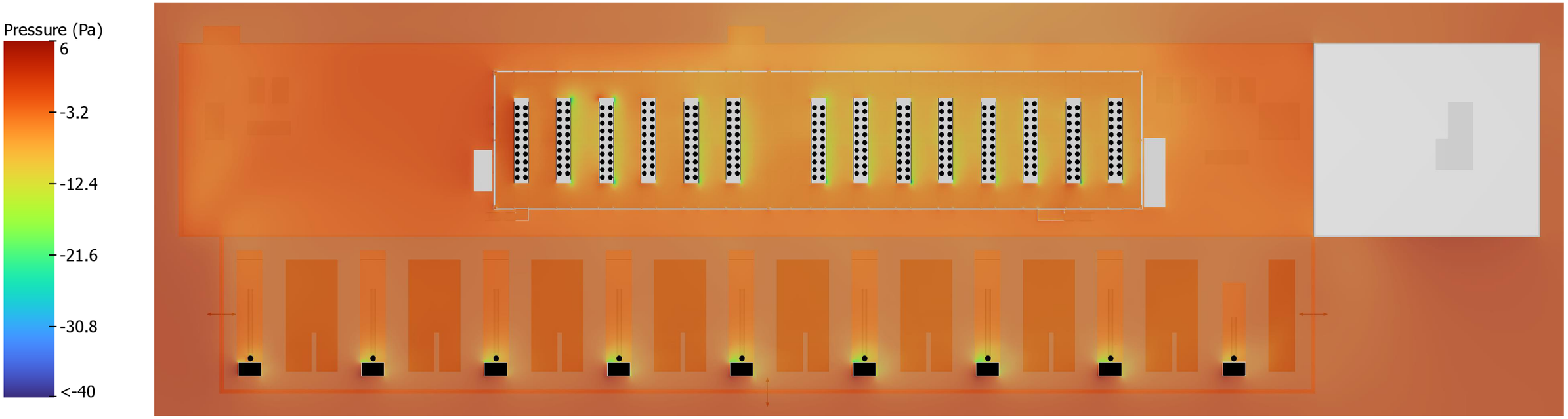


All the chillers have the air inlet temperature below the 43°C.

Air pressure at the chillers inlets

The image below shows the pressure plot at the chillers air inlets.

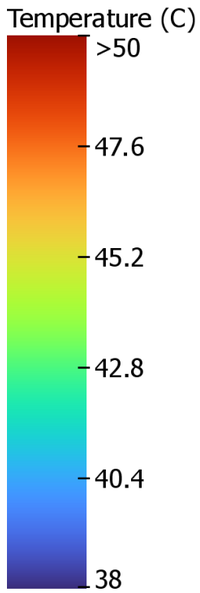
The mean ESP of the chillers is 9,1 Pa, while the maximum ESP is 9,7 Pa.

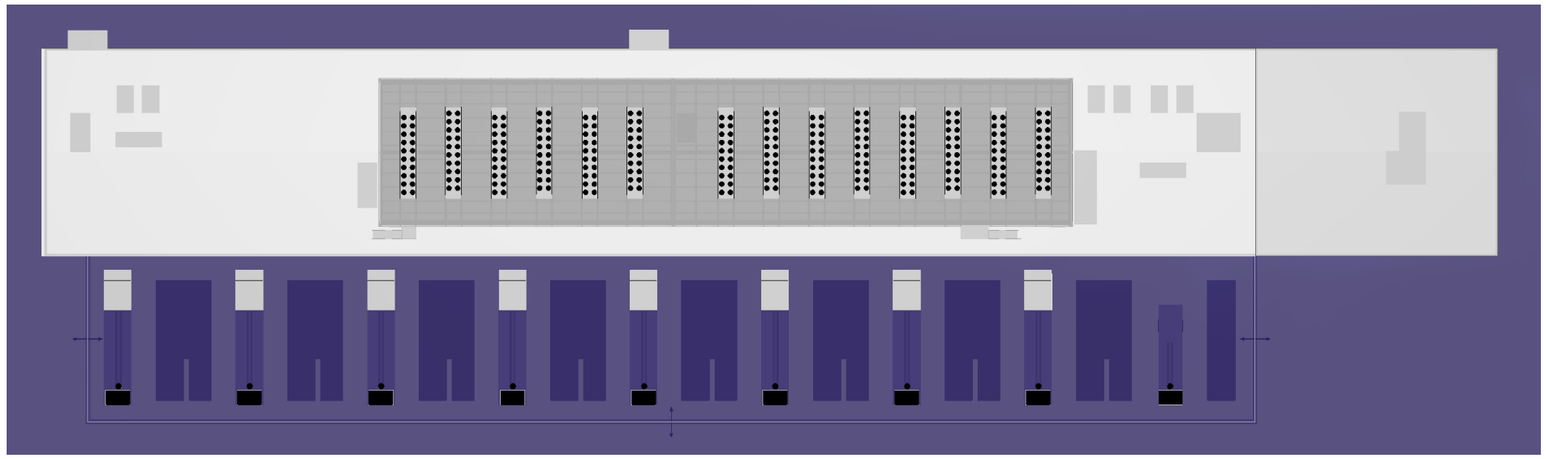


Air temperature at the generators inlets

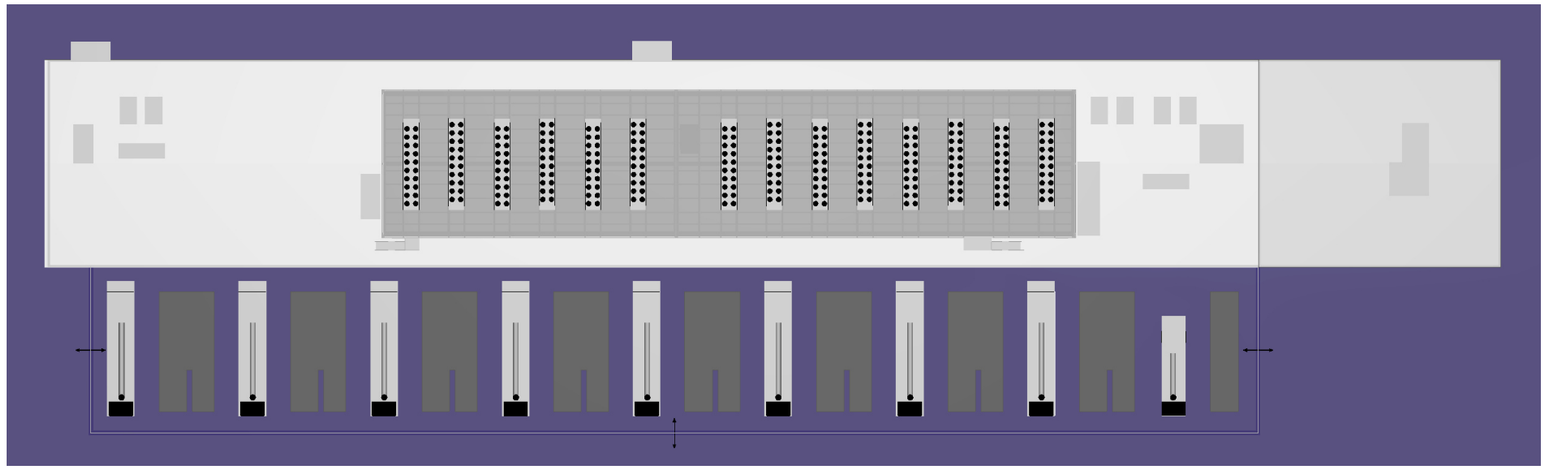
The image below shows the temperature plot at the generators inlets.

The inlet temperature of all the generators is equal to the external ambient temperature.





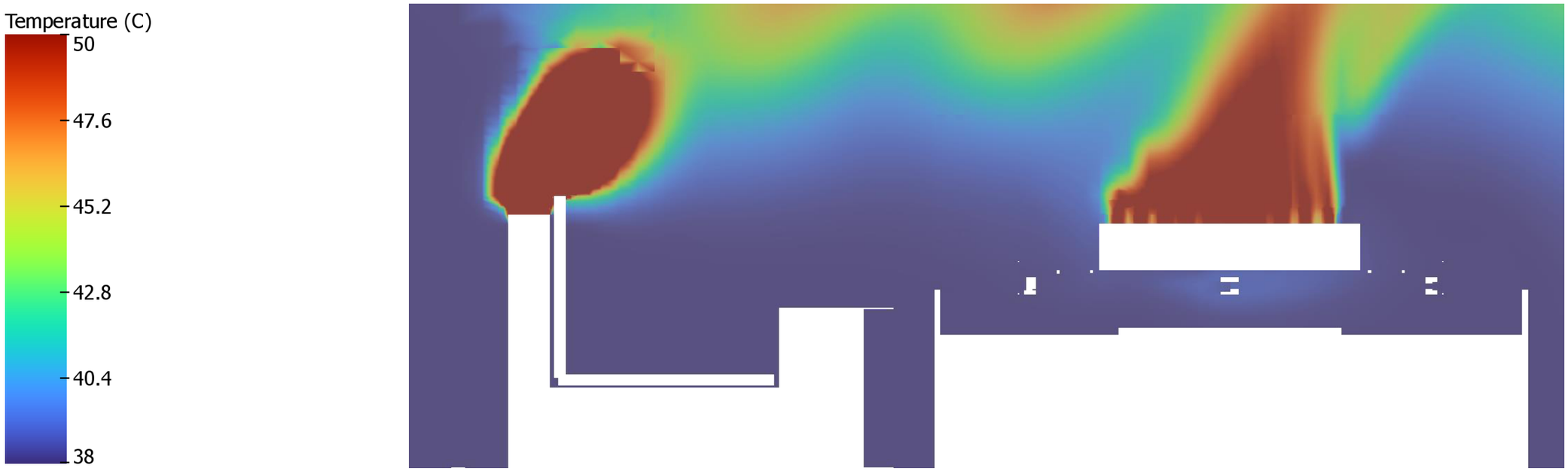
Temperature plot the air inlets of all the generators excluded generator LLG-1H



Temperature plot at the air inlet of generator LLG-1H

Air temperature at the generators inlets

The image below shows a section view of the temperatures in correspondence of the air inlet of a generator.
The inlet temperatures of the generators are not affected by the air outlets of the chimneys, generators and chillers.

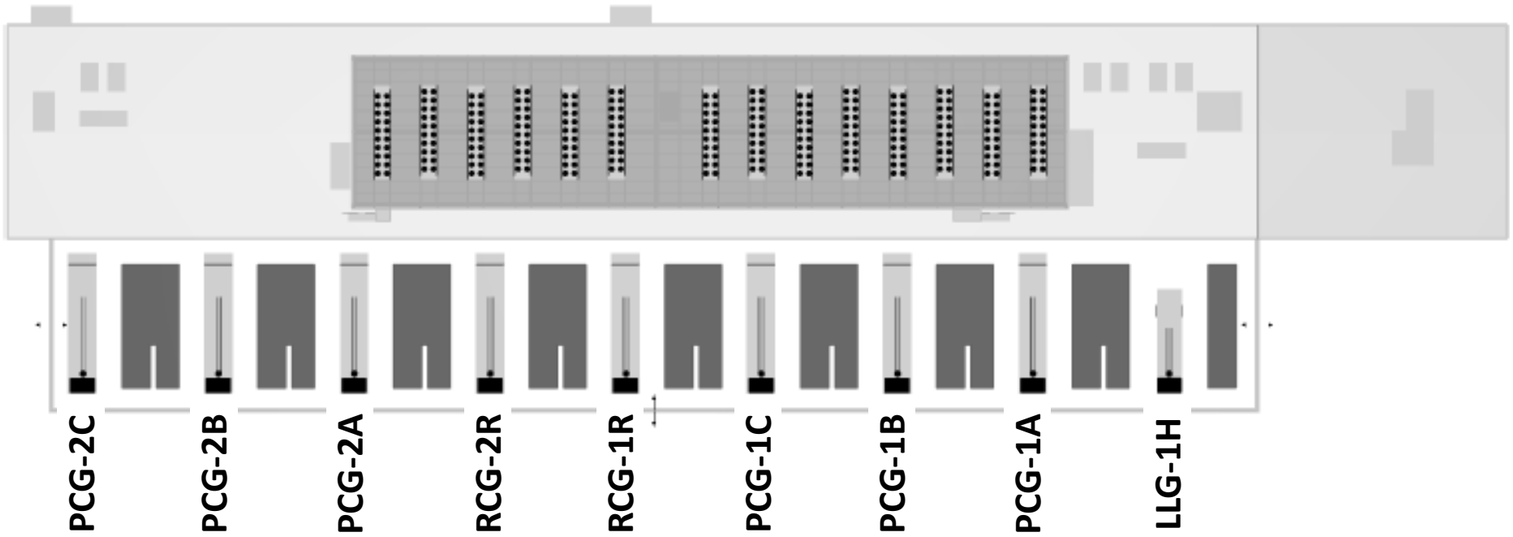


Air temperature at the generators inlets

Generator with inlet T under 40 °C

Generator with inlet T over 40 °C

Generator	Mean Inlet T (°C)	Maximum Inlet T (°C)	Delta T
LLG-1H	38.0	40.0	-2.0
PCG-1A	38.0	40.0	-2.0
PCG-1B	38.0	40.0	-2.0
PCG-1C	38.0	40.0	-2.0
RCG-1R	38.0	40.0	-2.0
PCG-2R	38.0	40.0	-2.0
PCG-2A	38.0	40.0	-2.0
PCG-2B	38.0	40.0	-2.0
PCG-2C	38.0	40.0	-2.0



The inlet temperature of the generators is equal to the external ambient temperature.

Conclusions

Conclusions

In all the cases analyzed, the chillers inlet temperatures are not affected by the outflows from the generators or the chimneys. However, due to air recirculation between the units, the chillers inlet temperature is higher than the external ambient temperature. Nevertheless the inlet temperature of all the chillers remain below 43°C.

In all the cases analyzed, the generators inlet temperatures are not influenced by the air outlets of the chimneys, generators, or chillers, therefore, the generators inlet temperature remains equal to the external ambient temperature.

Therefore, the layout of the campus, the design summer temperature of the chillers (43 °C) and the maximum inlet temperature of the generators (40°C) are approvable from a CFD prospective.

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STACK INFRASTRUCTURE MIL07

CFD – Electrical Pods

POI: S4 – Suitable for stage approvale

Reference: MIL07-DBA-EX-XX-CA-M-55041

Revision: P01

Date: 7th November 2025

Document title:	Calculation - CFD - Electrical Pods
Reference:	MIL07-DBA-EX-XX-CA-M-55041
Status:	S4/P01
Date:	7th November 2025
Project name:	STACK INFRASTRUCTURE MIL07
Project number:	13038001
Authors:	Marco Colombo / Luca Guarino
Drafted by:	Marco Colombo / Luca Guarino
Checked by:	Gaetano Russo
Date:	7th November 2025
Approved by:	Sacha Busetti
Date:	7th November 2025

Introduction

This report presents the results of the Computational Fluid Dynamics (CFD) simulation of the cooling performance of the WS3 project layout for LV Room 1 and LV Room 2, located inside the electrical pods. The final CFD analysis shall be performed by the container vendor on the final layout.

The goals are:

- Check that the mean inlet temperatures of the UPS units PCU-1, PCU-2 and PCU2 , and STS units STS-1 and STS-2 are below 35°C, considering that the limit inlet temperature of 40°C.
- Check that the temperature at the front of the electrical panels is below 40°C.
- Check the mean air temperature inside LV Room 1 and LV Room 2.

For each room, the simulation will be performed for the normal operation condition, with two CRAH units operating (N+1), and for the failure scenario, with only one CRAH unit operating (N). Precedent studies have shown that inside LV room 1 the worst case scenario is with the fail of CRAH-1, while in LV room 2 is with the fail of CRAH-2.

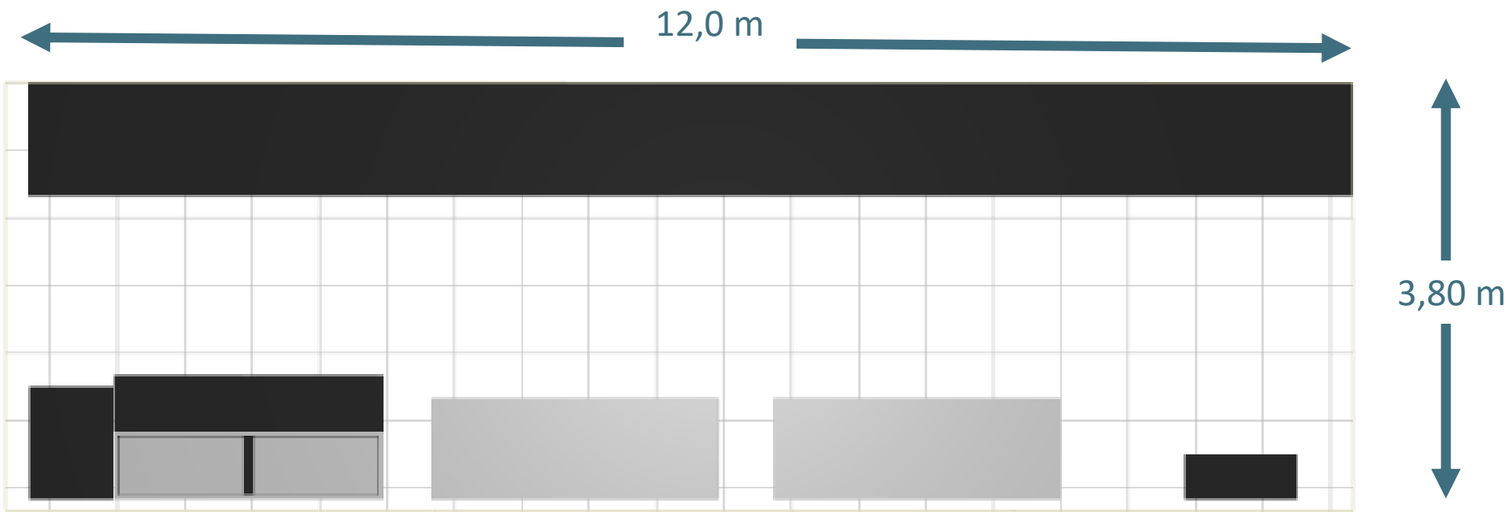
CFD software: Cadence Reality DC Design.

CFD Inputs: LV Room 1

CFD Model

Based on the Revit model

- LV room dimension: 12,0 (L) x 3,8 (W) x 3,7 (H)

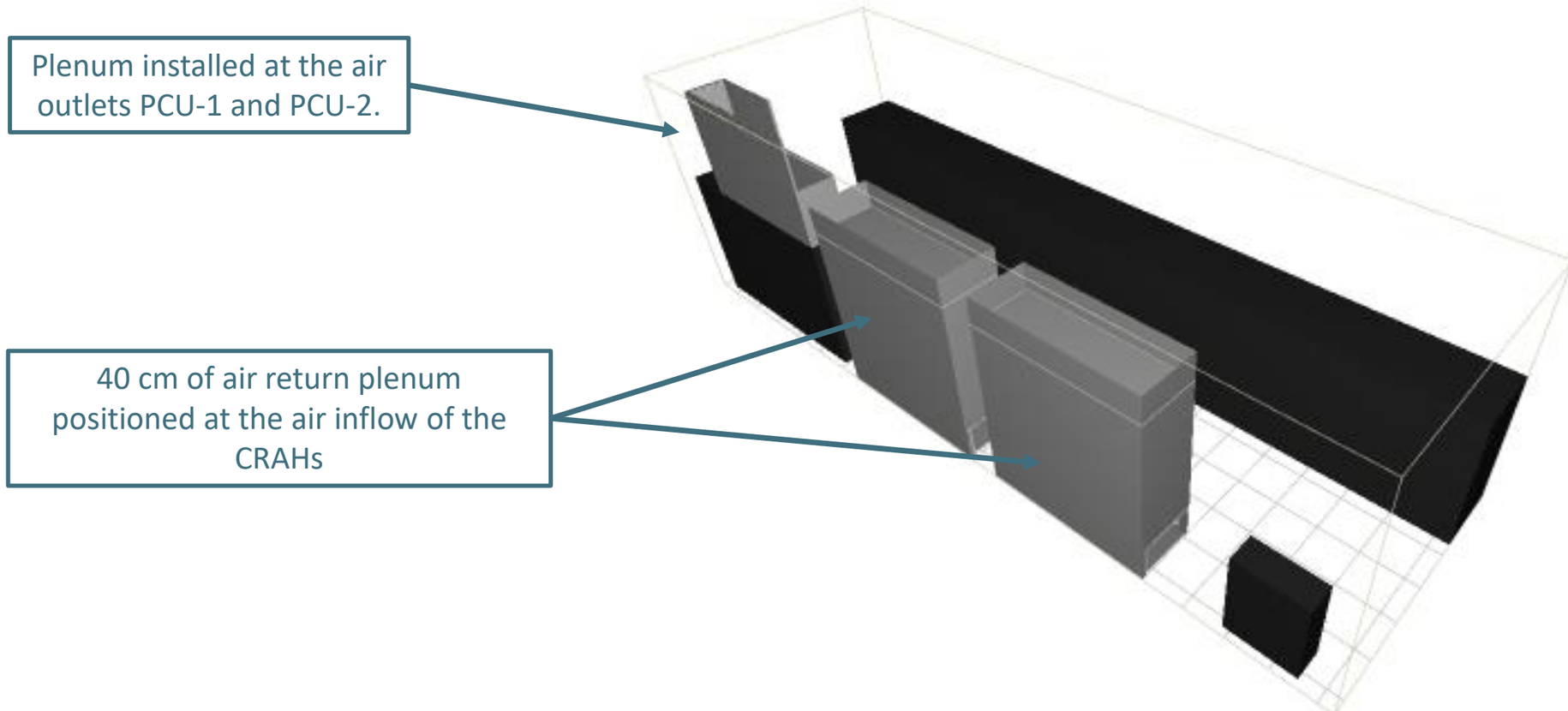


LV Room 1 Planview from CFD Model

LV Room 1 Section from CFD Model

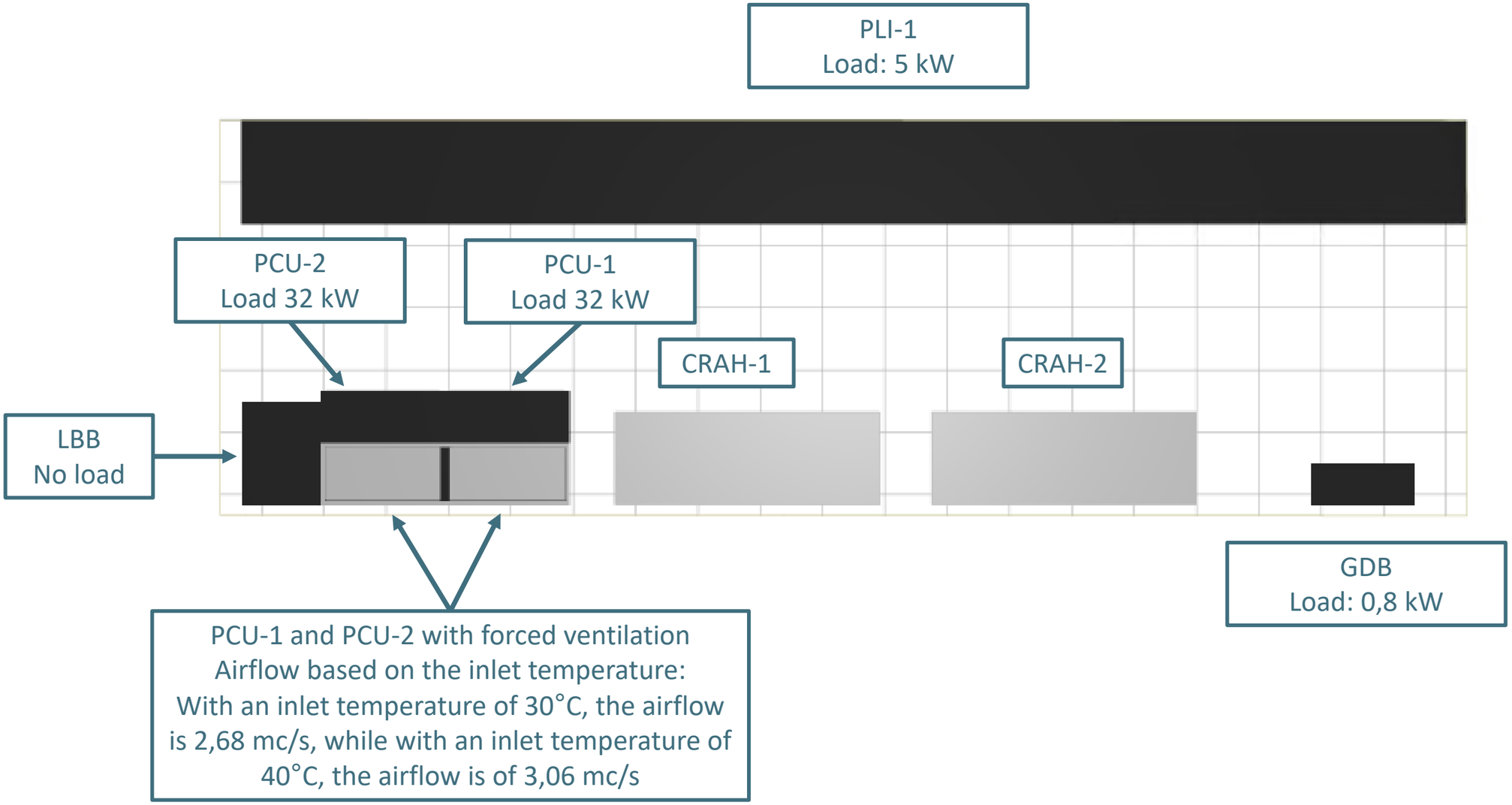
Layout

The plenum installed at the air inlet of the CRAHs is considered in all simulations, while the plenum installed at the air outlets of PCU-1 and PCU-2 is considered only in Case 2 and Case 3 simulations. The plenums at the air outlets of the UPS units are possible measures that can be implemented by the vendor to improve the cooling efficiency in the room.



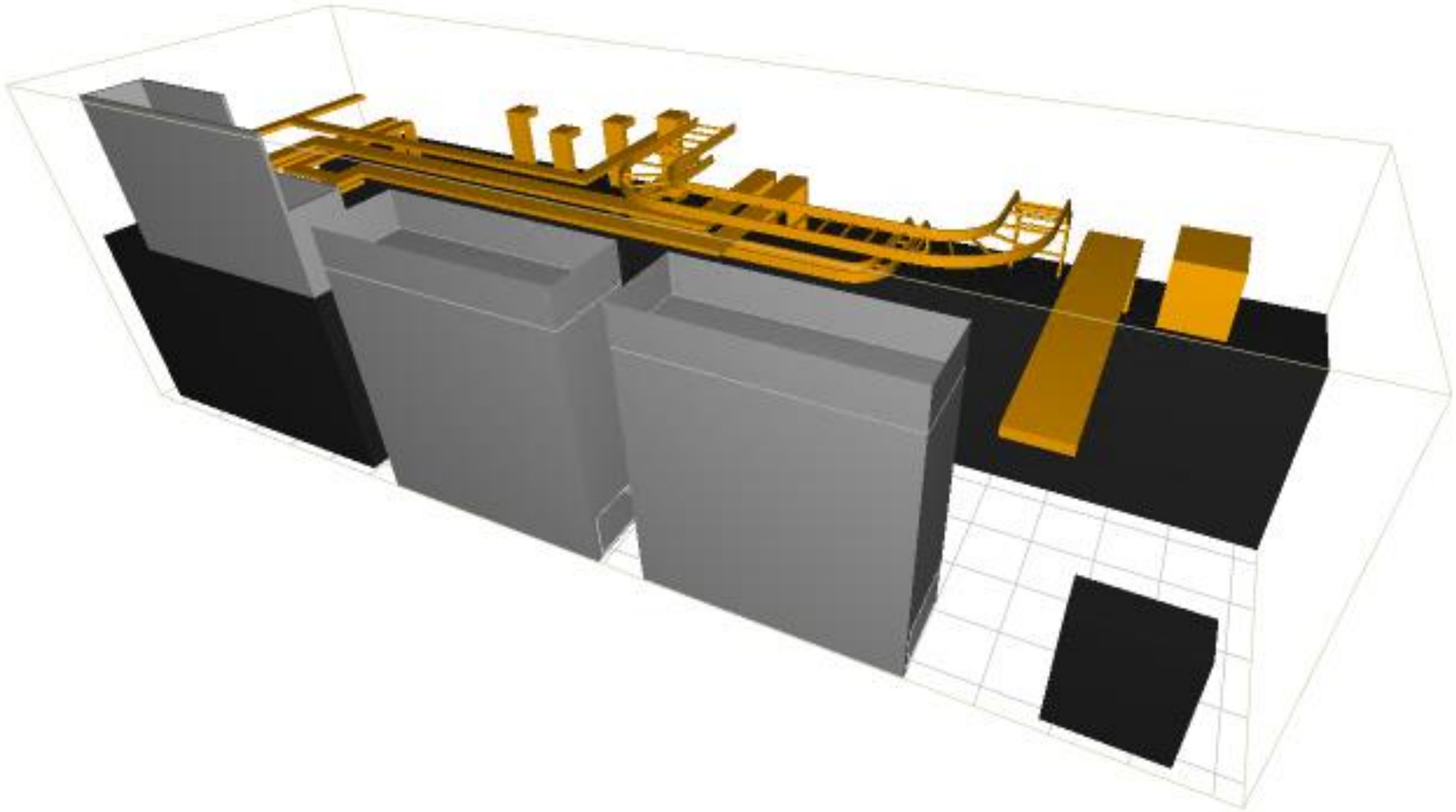
Electrical equipments

LV room 1 load and airflow of the electrical equipment



Electrical distribution

- 20 kW of load from electrical distribution:
  - 4,0 kW of load from cabling
  - 16,0 kW of load from busbar



CRAH specification

- Vendor: Vertiv
- Model: PW136DSE3
- Dimensions: 2550 mm(W) x 890mm(D) x 2570mm (H)
- Net cooling capacity: 105 kW
- Airflow: 35520 mc/h
- Supply air temperature setpoint: 27,8 °C (+/-0.1 K dead band)
- Return air temperature setpoint: 37,0 °C (+/-0.1 K dead band)

PW136DSE3

Extended Height,Downflow Up Front Delivery,Smart coil,EC Fan Advanced - HE

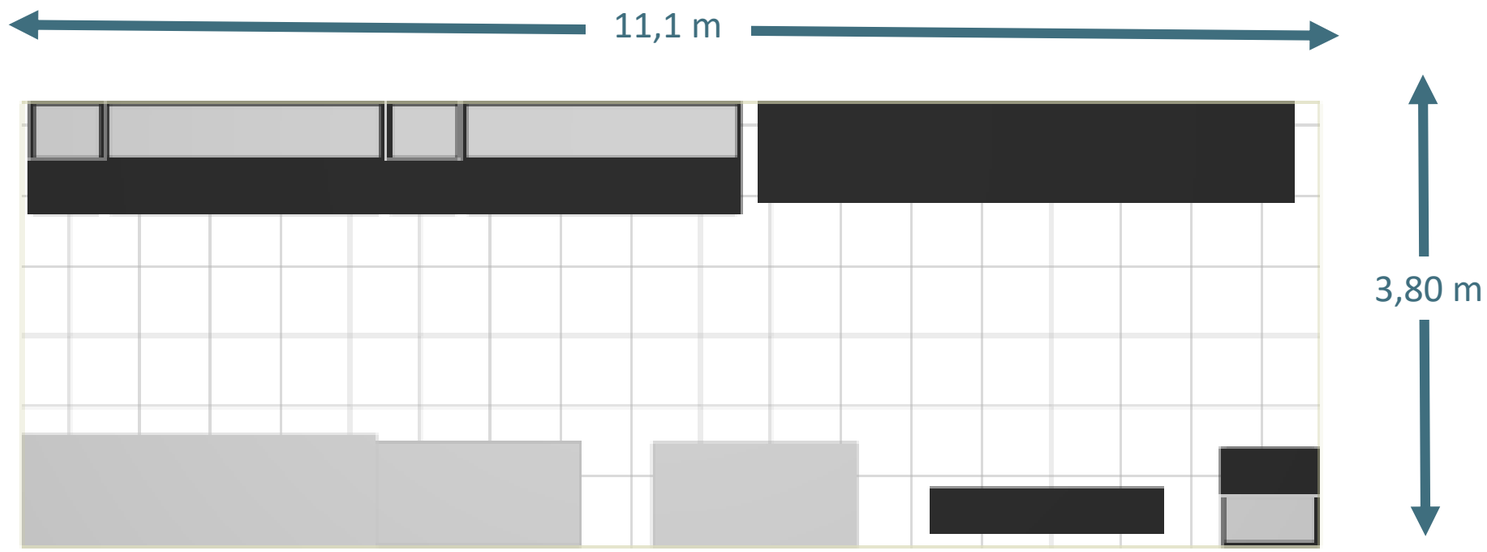
Unit inlet air temperature	**37,0**	°C	Fluid	**WATER**	
Unit inlet air relative humidity	**30,0**	%	Inlet fluid temperature	**23,0**	°C
Unit airflow	**35520**	m³/h	Outlet fluid temperature	**33,0**	°C
ESP	**50**	Pa	Unit fluid flow	**2,71**	l/s
Sea level	**0**	m	Unit power supply	**400 V/3 ph/50 Hz**	
Unit performances					
Unit	**PW136DSE3**		Unit power input	**7,56**	kW
Net total cooling capacity	**105,0**	kW	Unit Net Sens EER	**13,90**	
Net sensible cooling capacity	**105,0**	kW	Unit Net Total EER	**13,90**	
nSHR	**1,00**		Internal filter class (EN16890 std)	**ePM10 50%**	
Gross total cooling capacity	**112,6**	kW	Unit air pressure drop	**378**	Pa
Gross sensible cooling capacity	**112,6**	kW	Internal filter air pressure drop	**53**	Pa
Supply air temperature	**27,8**	°C	Coil air pressure drop	**135**	Pa
Supply air relative humidity	**50,3**	%	Depth	**890**	mm
Room SPL (@ 2m, f.f)	**79**	dB(A)	Width	**2550**	mm
			Height	**2570**	mm
			Weight	**861**	kg
CW Coils					
Quantity	**1**	n°	Fluid pressure drop coil+connections	**33**	kPa
Unit fluid flow	**2,71**	l/s	PIC Valve pressure drop/max	**8/350**	kPa
Unit fluid side pressure drop	**42**	kPa	PIC Valve max flow rate	**5,6**	l/s
PIC Valve model	**EP040R2+BAC_v1**		PIC Valve flow rate setting	**49**	%
CW Fans					
Quantity	**3**	n°	Operating Ampere	**3 x 3,83**	A
Type	**EC Fan Advanced - HE**		Full load Ampere	**3 x 5,1**	A
Power supply	**400 V/3 ph/50 Hz**		Locked rotor Amp.	**3 x 0,1**	A
Power input	**3 x 2,51**	kW	Room fan modulation (%)	**91,0**	%

CFD Inputs: LV Room 2

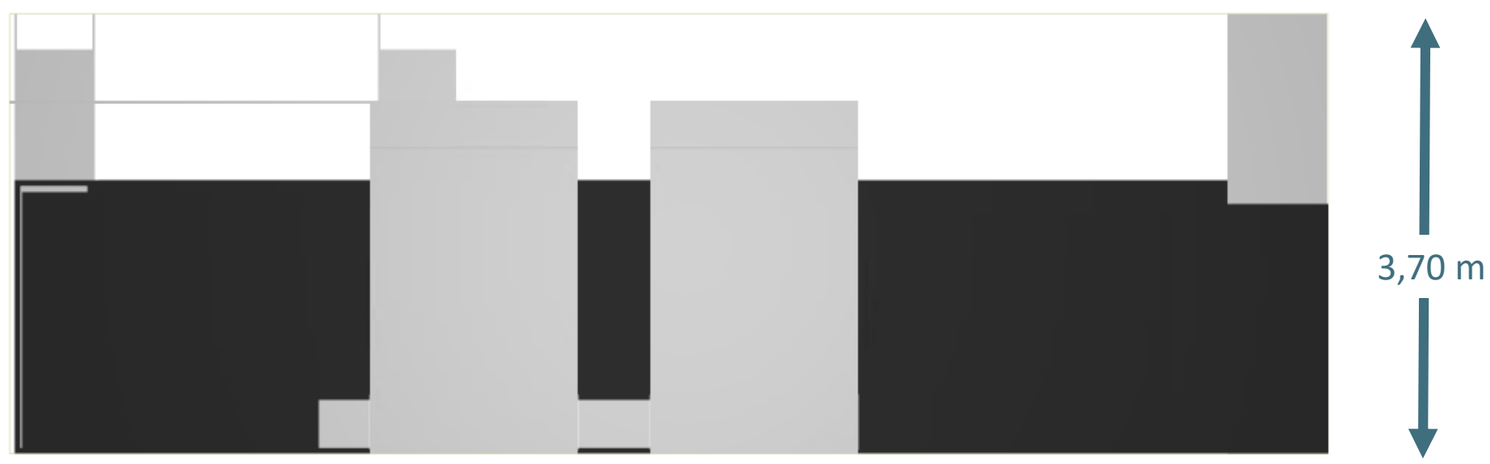
CFD Model: LV Room 2

Based on the Revit model

- LV room dimension: 11,1 (L) x 3,8 (W) x 3,7 (H)



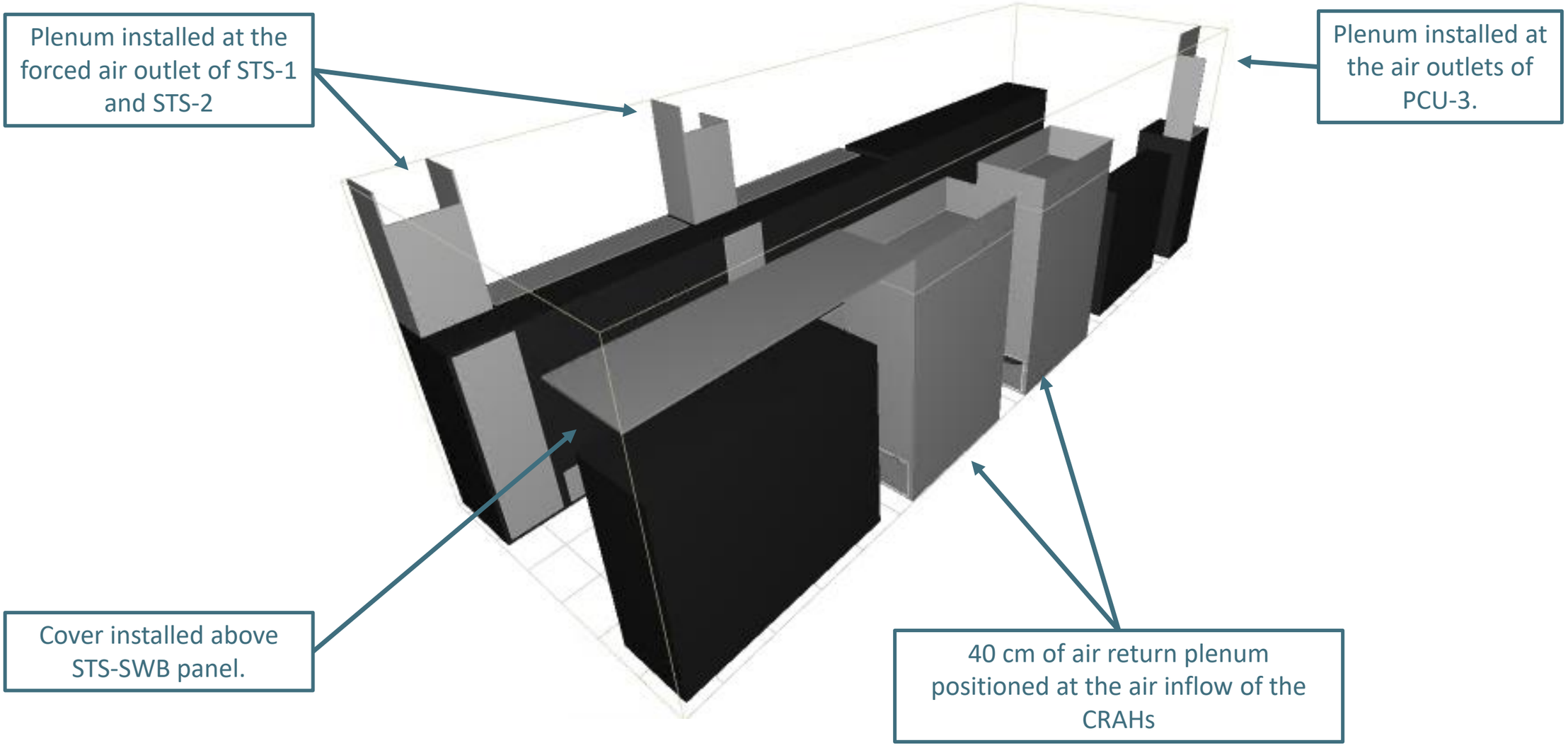
LV Room 2 Planview from CFD Model



LV Room 2 Section from CFD Model

Layout

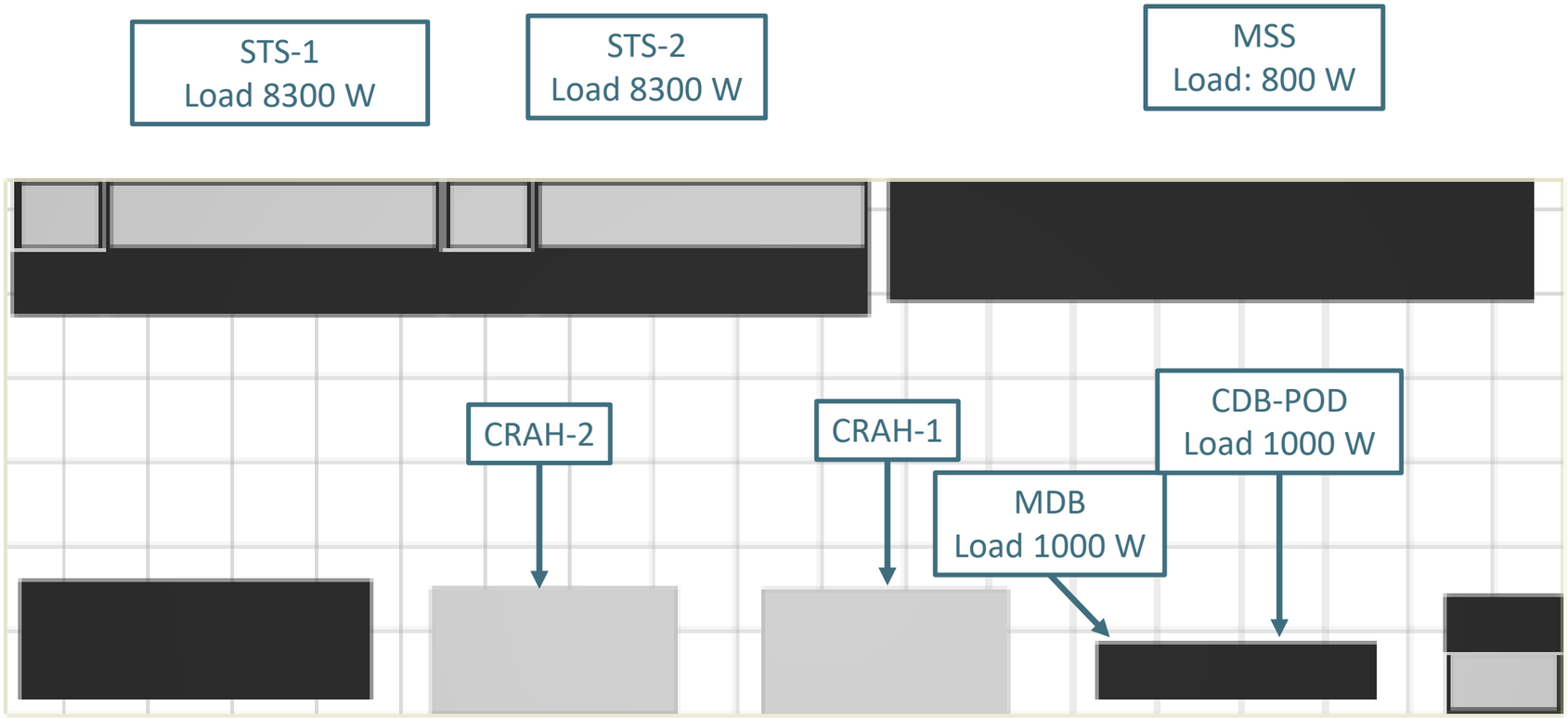
The plenum installed at the air inlet of the CRAHs is considered in all simulations, while the plenum installed at the air outlets of STS-1, STS-2, and PCU, as well as the cover above STS-SWB, are considered only in Case 5 and Case 6 simulations.
The plenums at the air outlets of STS-1, STS-2, and PCU, together with the cover above STS-SWB, are possible measures that can be implemented by the vendor to improve the cooling efficiency in the room.



Electrical equipments

LV room 2 load and airflow of the electrical equipment

STS-1 and STS-2
Composed by two part with different type of ventilation.
Part one:
Load 6,30 kW
Forced ventilation, with fixed airflow of 3000 mc/h
Part two:
Load 2 kW
Natural ventilation

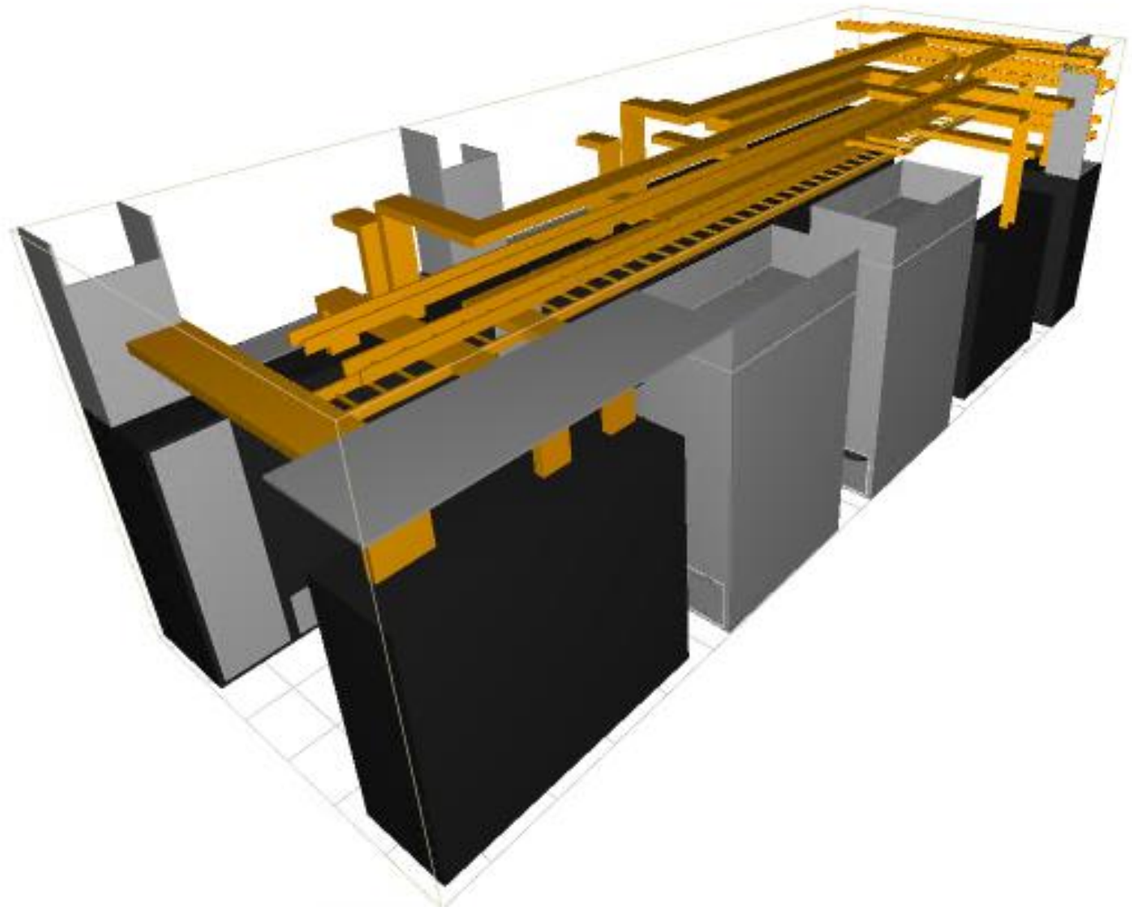


STS-SWB
Load 1700 W

PCU-3
Load: 7700 W
Forced ventilation
Airflow based on the inlet temperature:
With an inlet temperature of 30°C, the airflow is 0,95 mc/s, while with an inlet temperature of 40°C, the airflow is of 1 mc/s

Electrical distribution

- 14 kW of load from electrical distribution:
  - 3 kW of load from cabling
  - 11 kW of load from busbar



CRAH specification

- Vendor: Vertiv
- Model: PW066DSE3
- Dimensions: 1750 mm(W) x 890mm(D) x 2570mm (H)
- Net cooling capacity: 50 kW
- Airflow: 16620 mc/h
- Supply air temperature setpoint: 27,7 °C (+/-0.1 K dead band)
- Return air temperature setpoint: 37,0 °C (+/-0.1 K dead band)

PW066DSE3

Extended Height,Downflow Up Front Delivery,Smart coil,EC Fan Advanced - HE

Unit inlet air temperature	37,0	°C	Fluid	WATER	
Unit inlet air relative humidity	30,0	%	Inlet fluid temperature	23,0	°C
Unit airflow	16620	m³/h	Outlet fluid temperature	33,0	°C
ESP	50	Pa	Unit fluid flow	1,25	l/s
Sea level	0	m	Unit power supply	400 V/3 ph/50 Hz	
Unit performances					
Unit	PW066DSE3		Unit power input	2,11	kW
Net total cooling capacity	50,0	kW	Unit Net Sens EER	23,70	
Net sensible cooling capacity	50,0	kW	Unit Net Total EER	23,70	
nSHR	1,00		Internal filter class (EN16890 std)	ePM10 50%	
Gross total cooling capacity	52,1	kW	Unit air pressure drop	207	Pa
Gross sensible cooling capacity	52,1	kW	Internal filter air pressure drop	28	Pa
Supply air temperature	27,7	°C	Coil air pressure drop	64	Pa
Supply air relative humidity	50,6	%	Depth	890	mm
Room SPL (@ 2m, f.f)	67	dB(A)	Width	1750	mm
			Height	2570	mm
			Weight	610	kg
CW Coils					
Quantity	1	n°	Fluid pressure drop coil+connections	23	kPa
Unit fluid flow	1,25	l/s	PIC Valve pressure drop/max	6/350	kPa
Unit fluid side pressure drop	28	kPa	PIC Valve max flow rate	2,8	l/s
PIC Valve model	EP040R2+BAC_v1		PIC Valve flow rate setting	45	%
CW Fans					
Quantity	2	n°	Operating Ampere	2 x 1,58	A
Type	EC Fan Advanced - HE		Full load Ampere	2 x 5,1	A
Power supply	400 V/3 ph/50 Hz		Locked rotor Amp.	2 x 0,1	A
Power input	2 x 1,04	kW	Room fan modulation (%)	66,0	%

Cases evaluated

LV room 1 analysis:

Case 1:

- CRAHs working in normal operation (N+2).
- Airflow control based on the maximum return air temperature detected by the CRAHs (one control zone).
- No plenum installed above the UPSs.

Case 2:

- CRAHs working in normal operation (N+2).
- Airflow control based on the maximum return air temperature detected by the CRAHs (one control zone).
- Plenum installed above the UPSs.

Case 3:

- CRAH working in failure operation (N).
- Airflow control based on the air return temperature detected by the CRAH.
- Plenum installed above the UPSs.

Cases evaluated

LV room 2 analysis:

Case 4:

- CRAHs working in normal operation (N+2).
- Airflow control based on the maximum return air temperature detected by the CRAHs (one control zone).
- No plenums and cover installed above the UPS and STS units.

Case 5:

- CRAHs working in normal operation (N+2).
- Airflow control based on the maximum return air temperature detected by the CRAHs (one control zone).
- Plenum installed and cover installed above the UPS and STS units.

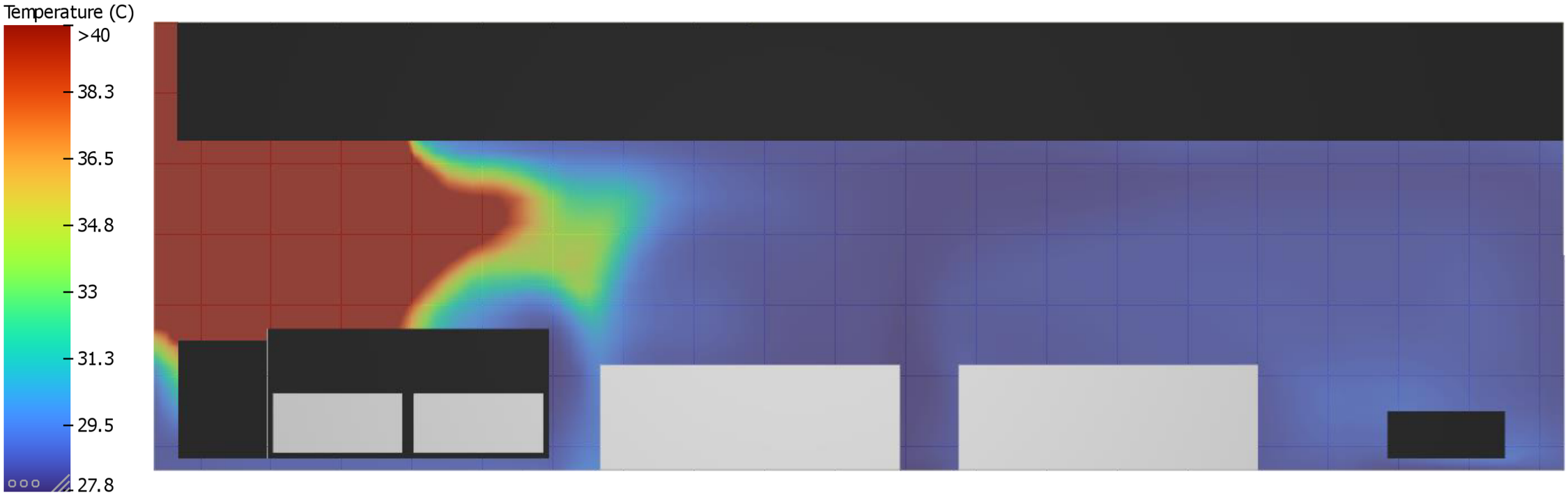
Case 6:

- CRAH working in failure operation (N).
- Airflow control based on the air return temperature detected by the CRAH.
- Plenum installed and cover installed above the UPS and STS units.

Results – Case 1 (LV room 1, Normal Operation, Without plenum above UPSs)

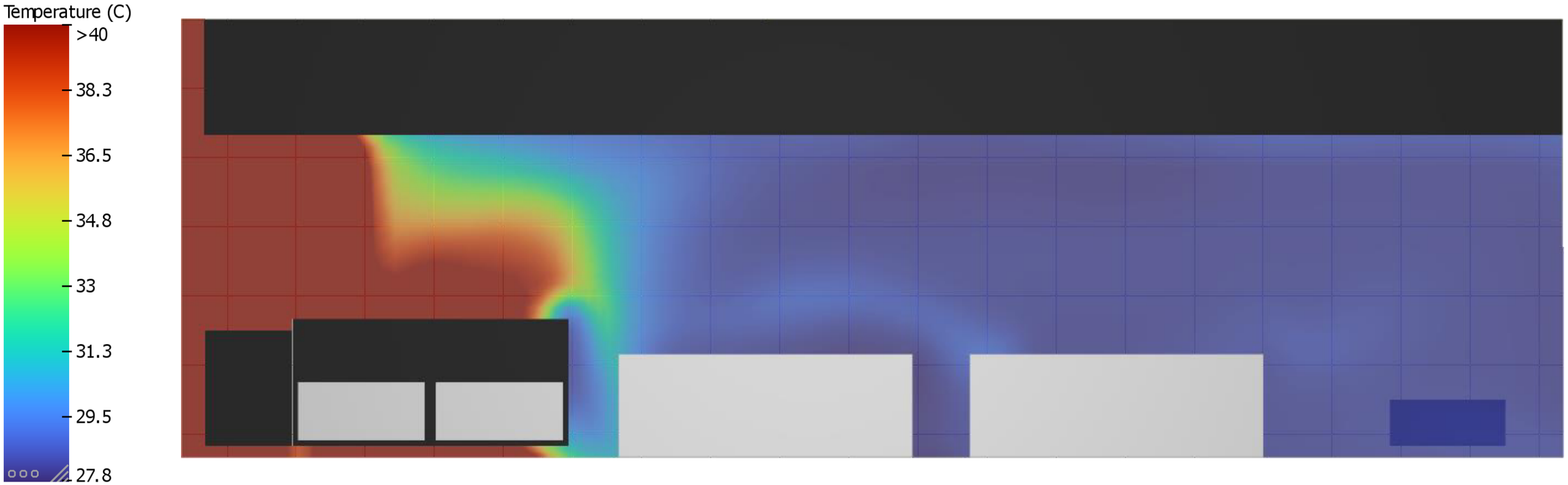
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 31,8°C



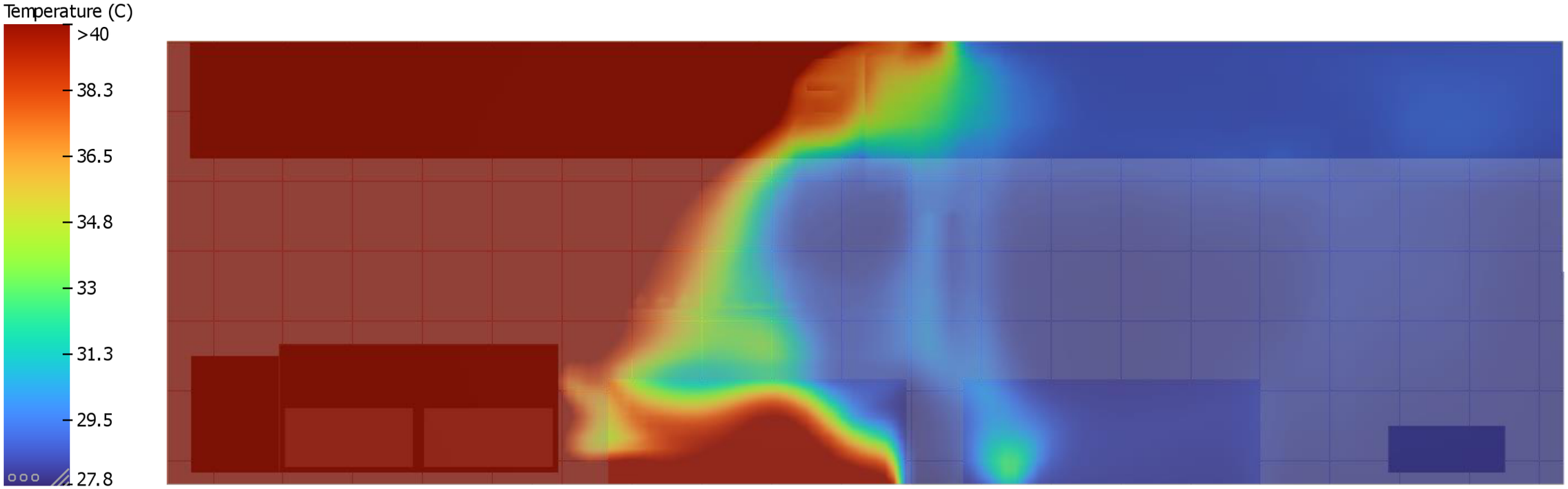
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 33,0°C



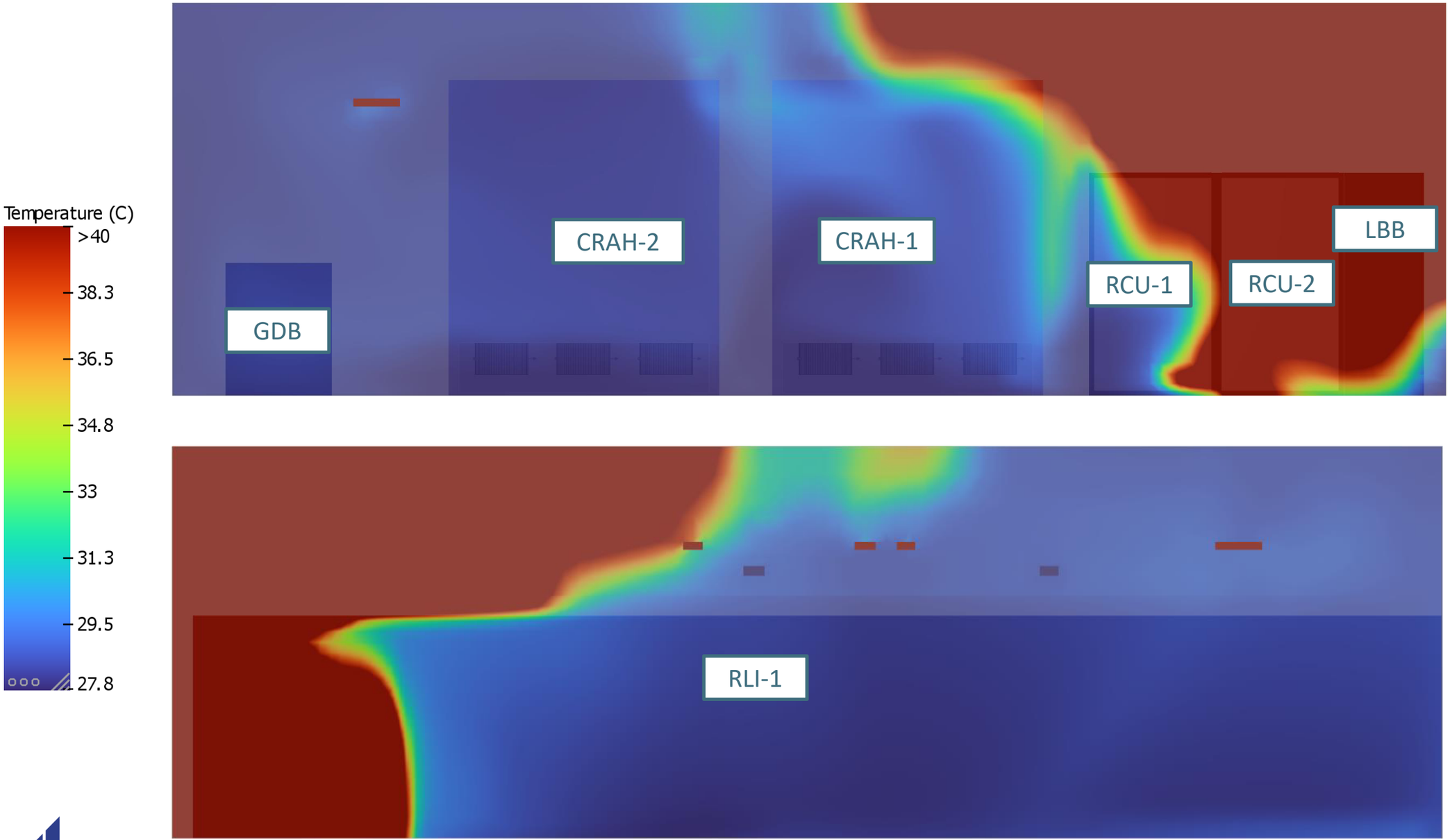
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 35,8°C



Temperature plot at the front of the UPS and electrical panels

The temperatures at the front of the electrical panels LBB and RLI-1 exceeds 40°C



Air inlet temperature of the UPS and room temperature

The mean inlet temperature of RCU-2 exceed 35°C.

	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
RCU-1	33,5	-1,5	The mean inlet temperature is less than 35°C
RCU-2	45,4	10,4	The mean inlet temperature is above 35°C and exceed the limit temperature of 40°C.

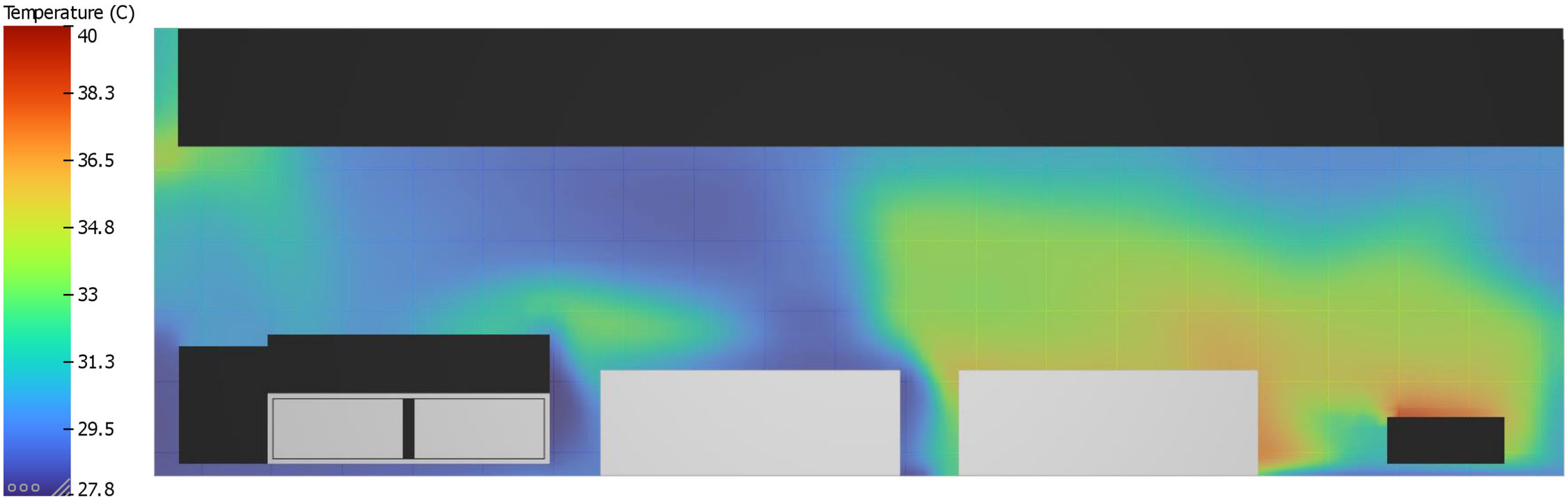
The mean temperature inside the room is 35,1°C.

As indicated in the table above and in the previews slide, due to the hot air coming from the outflow of the UPS units, PCU-1 and PCU-2, the mean inlet temperature of RCU-2 and the temperature at the front of electrical panels RLI-1 and LBB does not meet the verification.
A possible measure to reduce these temperatures is to install a plenum at the air outlets of the UPS units. Cases 2 and 3 analyze the cooling performances of LV Room 1 with the implementation of this plenum.

Results – Case 2 (LV room 1, Normal Operation, With plenum above UPS units)

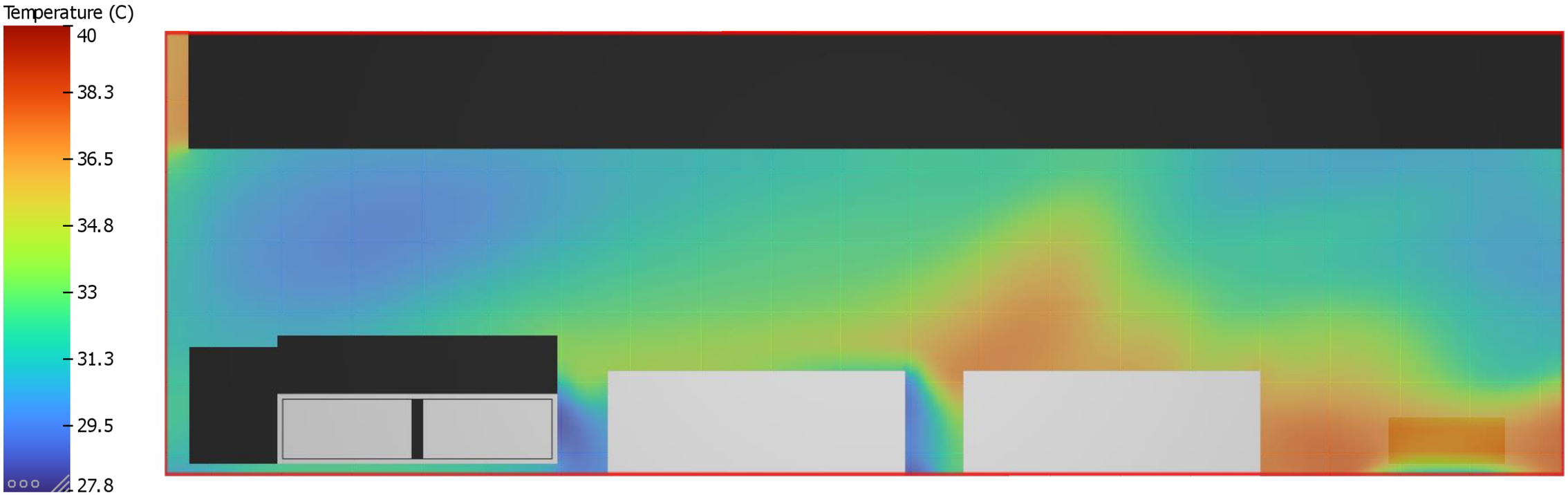
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 31,5°C



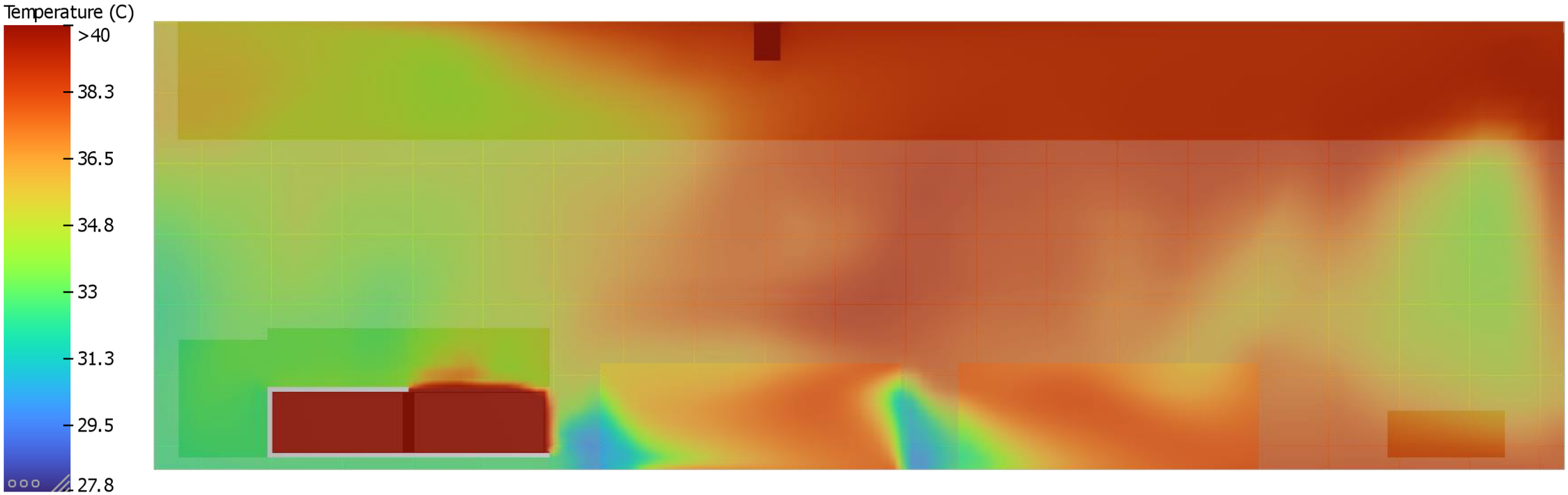
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 33,0°C



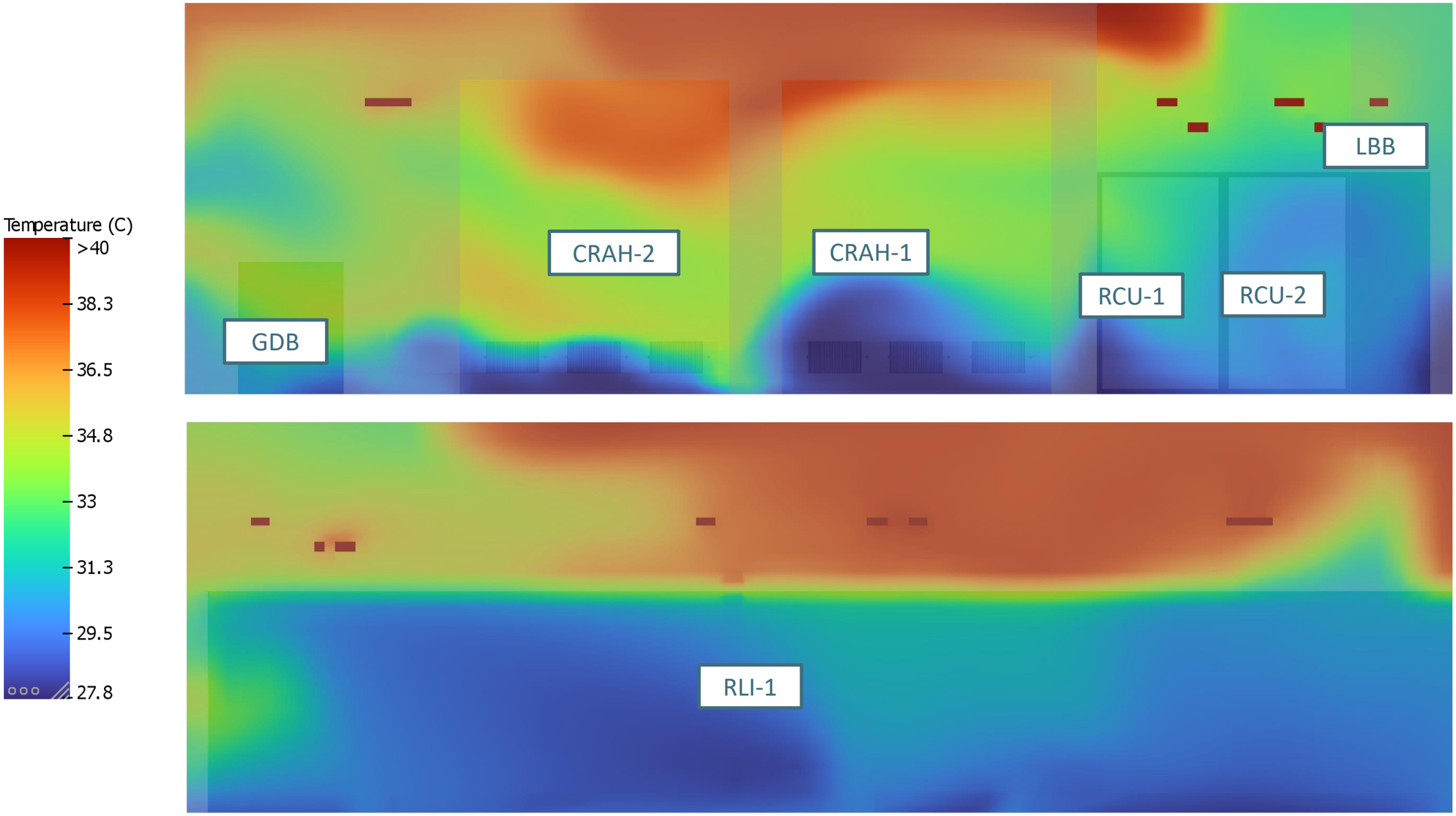
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 36,8°C



Temperature plot at the front of the UPS and electrical panels

The temperatures at the front of the UPS units and electrical panels are below 40°C.



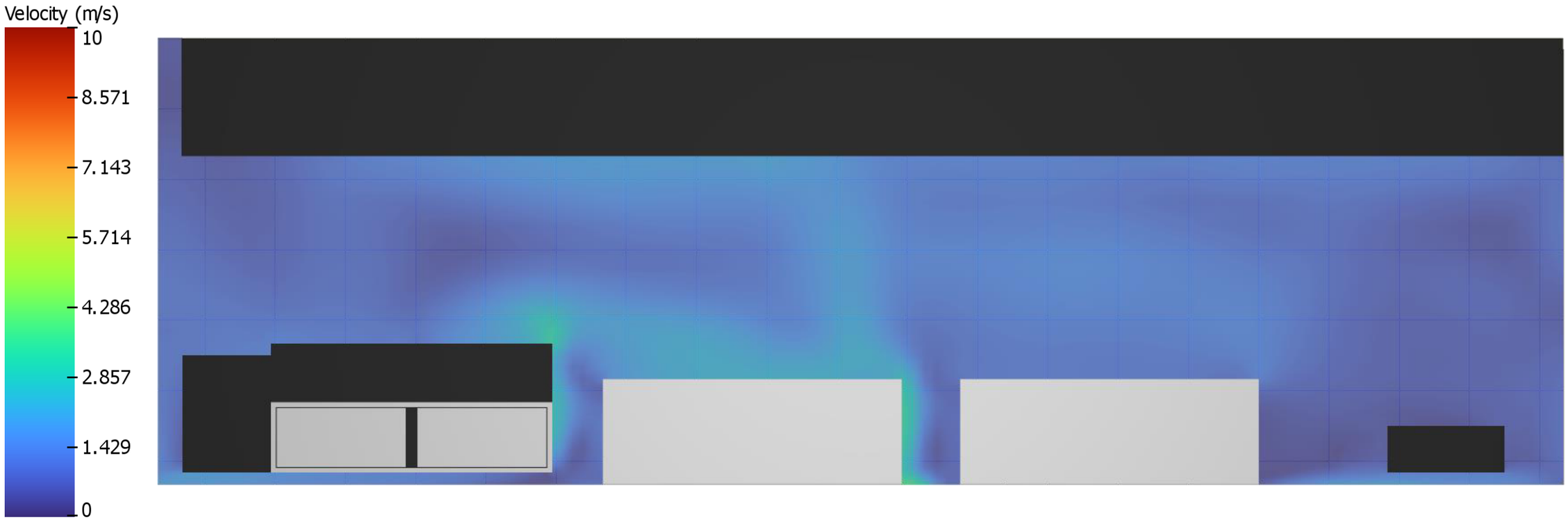
Air inlet temperature of the UPS and room temperature

All the UPS units have the mean inlet temperature below 35°C

	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
RCU-1	31,0	-4,0	The mean inlet temperature is less than 35°C
RCU-2	30,3	-4,7	The mean inlet temperature is less than 35°C

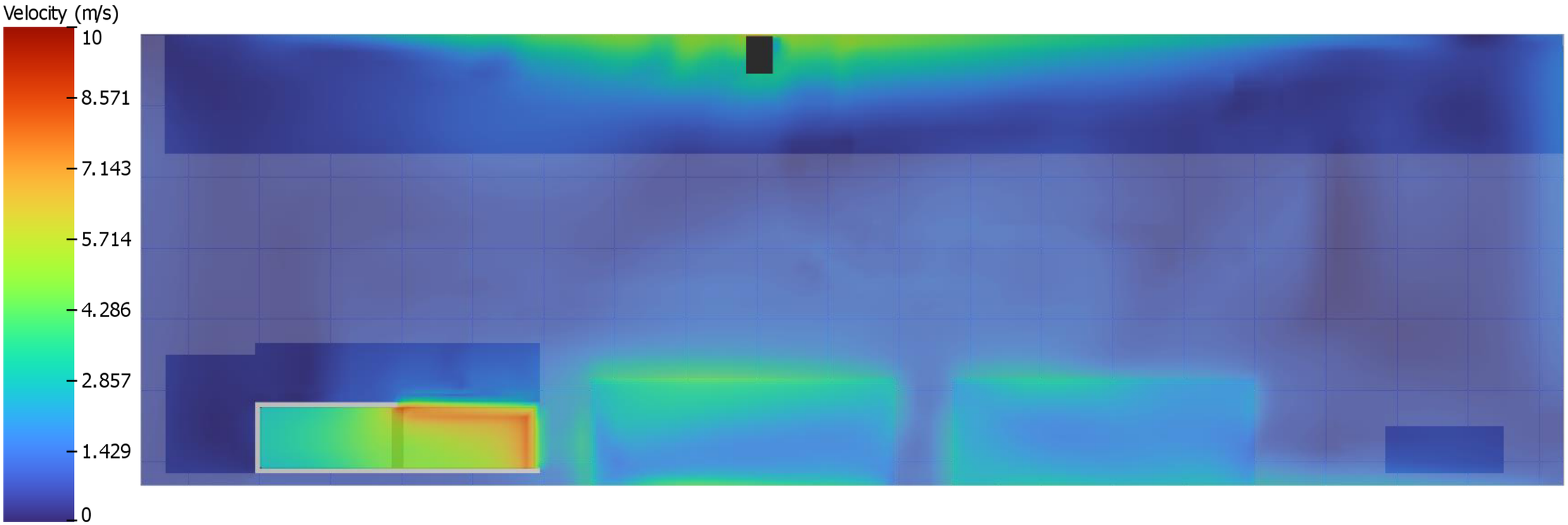
The mean temperature inside the room is 34,4°C

Velocity plot at 1 meter of height



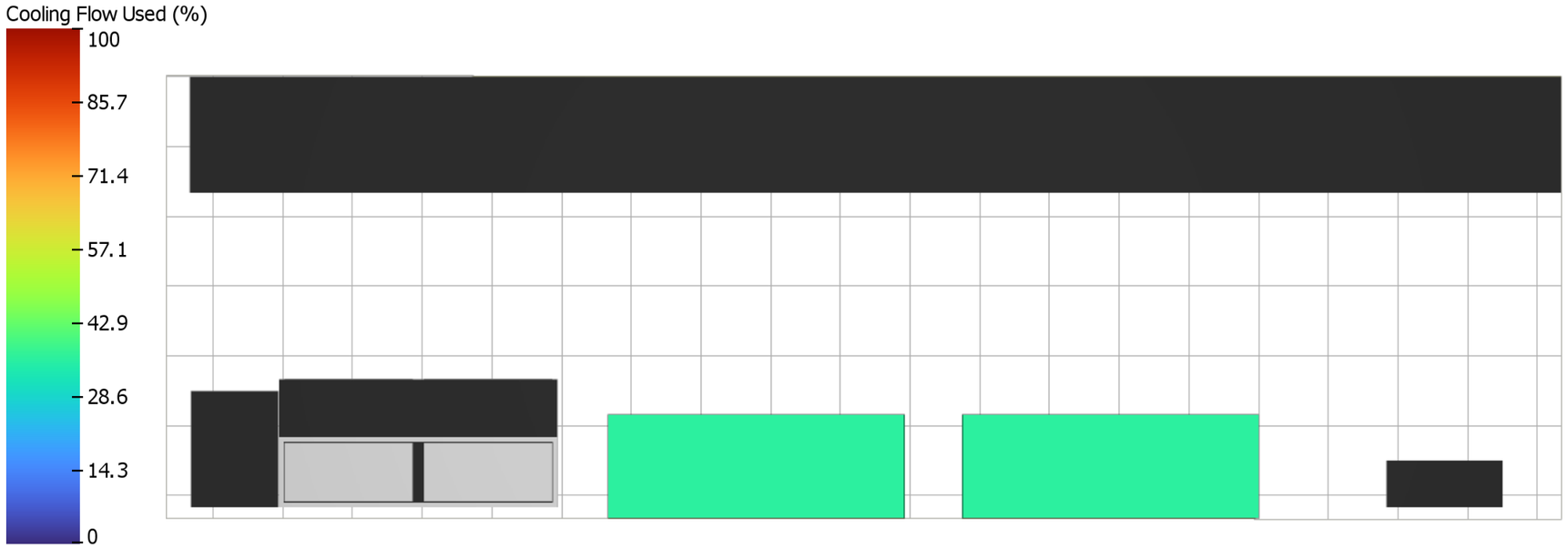
Velocity plot at 2 meter of height

Velocity plot at 3 meter of height

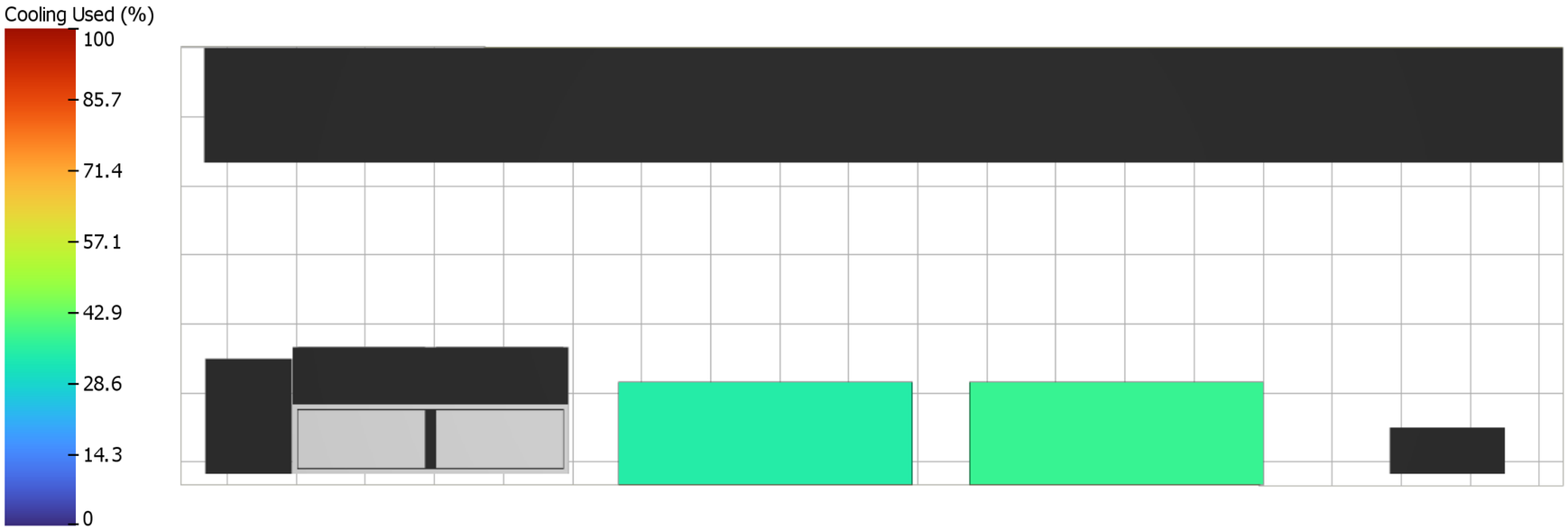


CRAHs airflow and cooling capacity usage

CRAHs airflow usage



CRAHs cooling capacity usage



Operating CRAHs datas:

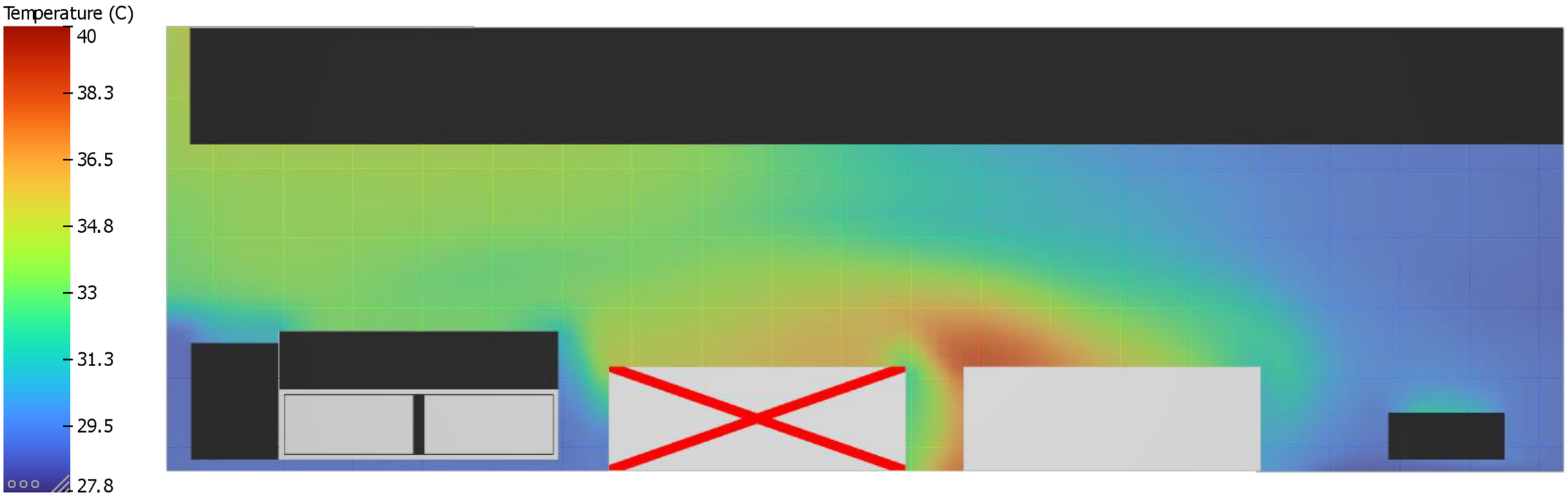
Average Net Cooling: 38,0 kW
Average Inrow Flow Rate: 3,55 mc/s

Average Supply Temperature: 27,8 °C
Average Return Temperature: 36,8 °C

Results – Case 3 (LV room 1, Failure Operation, With plenum above UPS units)

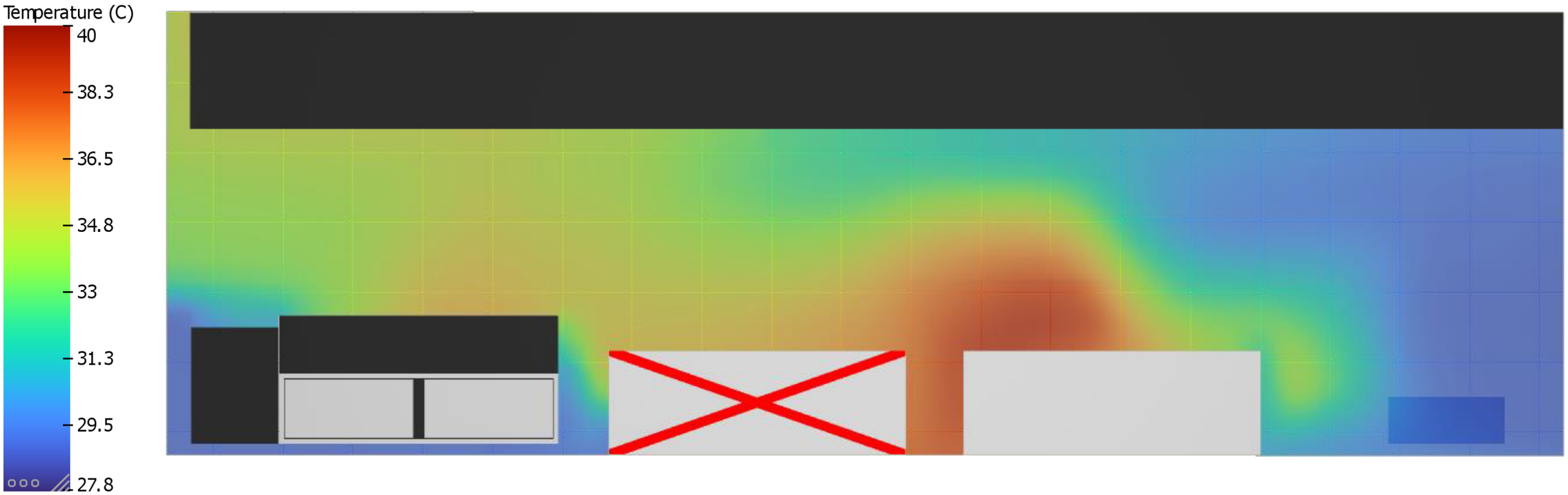
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 31,9°C



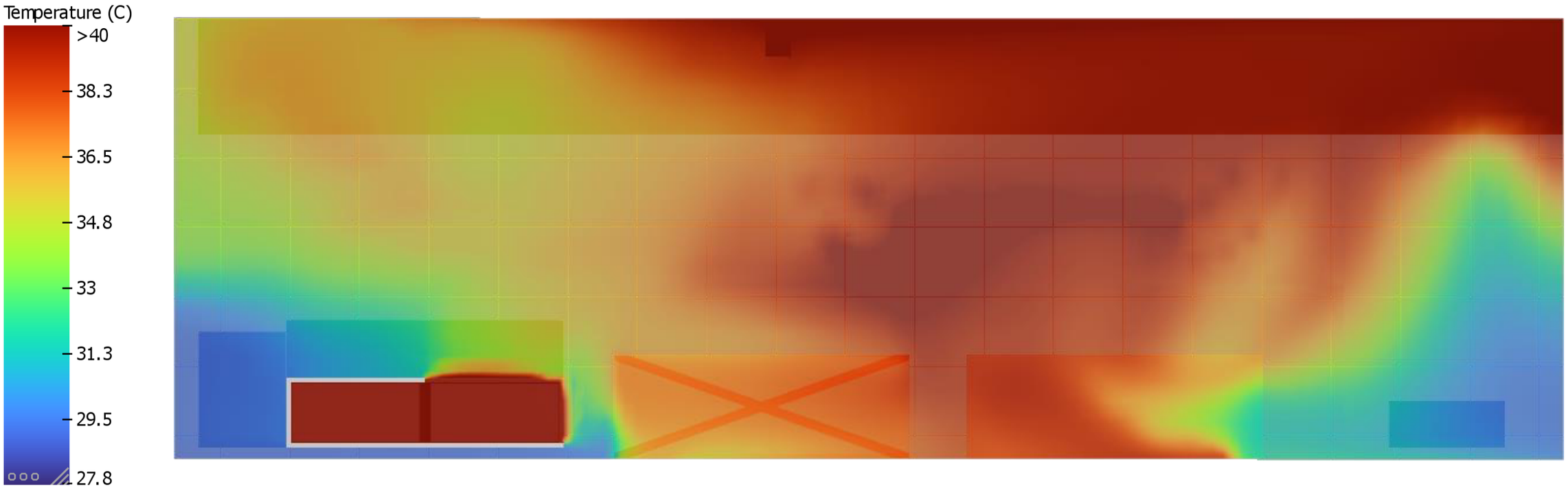
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 32,9°C



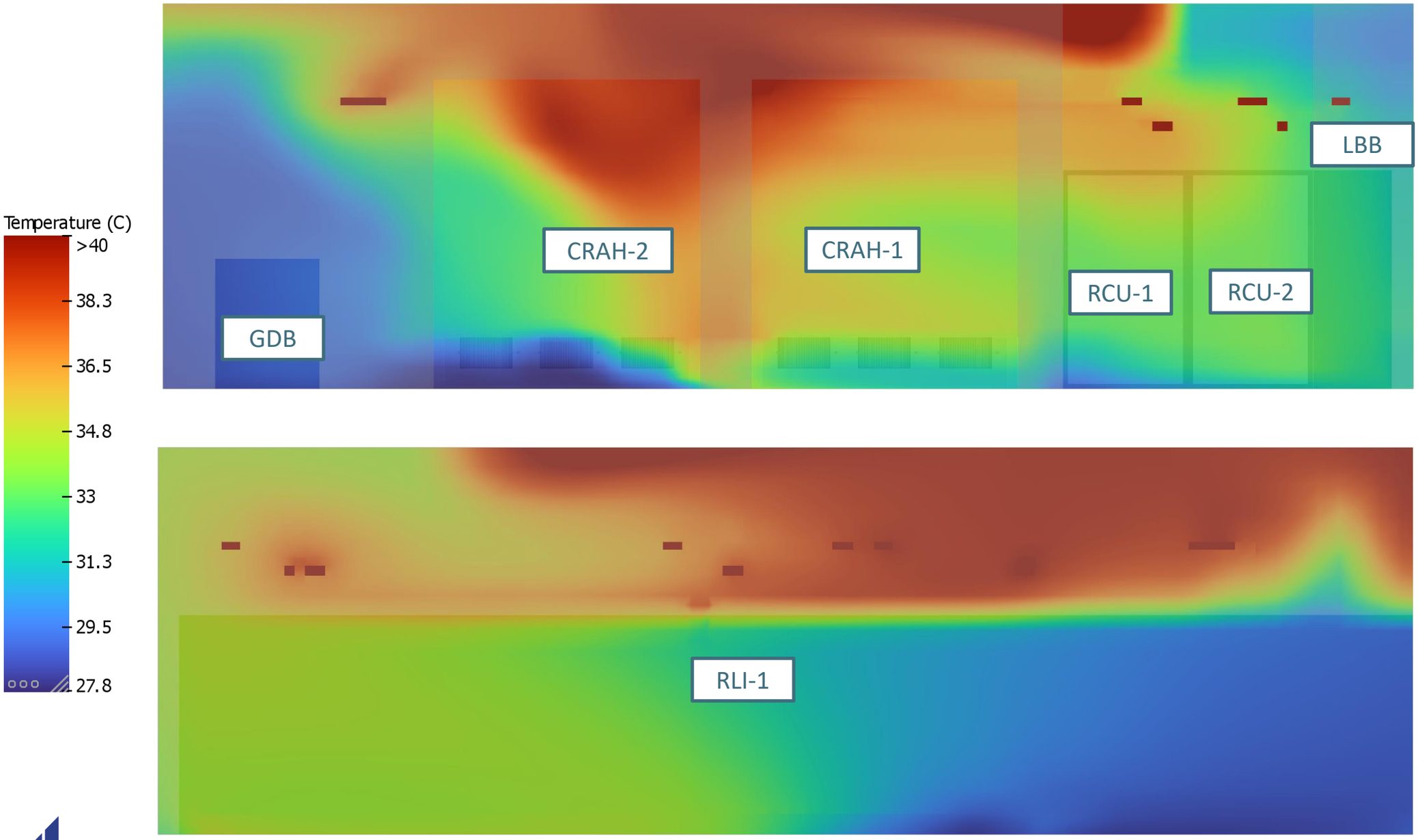
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 37,0°C



Temperature plot at the front of the UPS and electrical panels

The temperatures at the front of the UPS units and electrical panels are below 40°C.



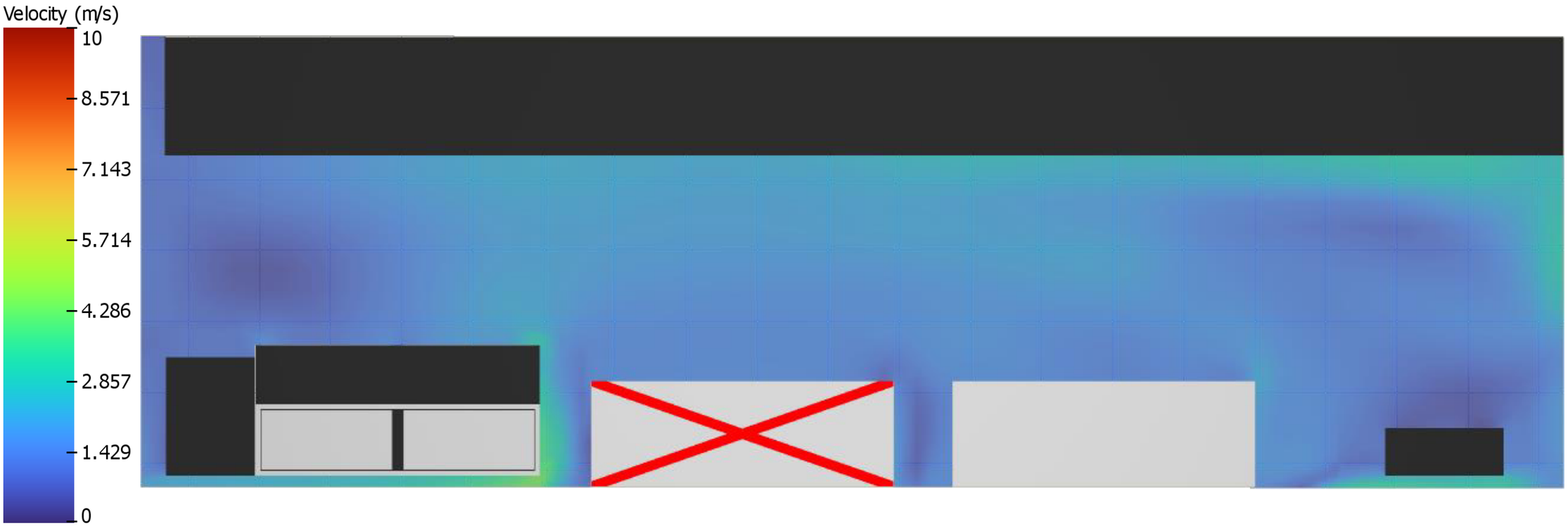
Air inlet temperature of the UPS and room temperature

All the UPS units have the mean inlet temperature below 35°C

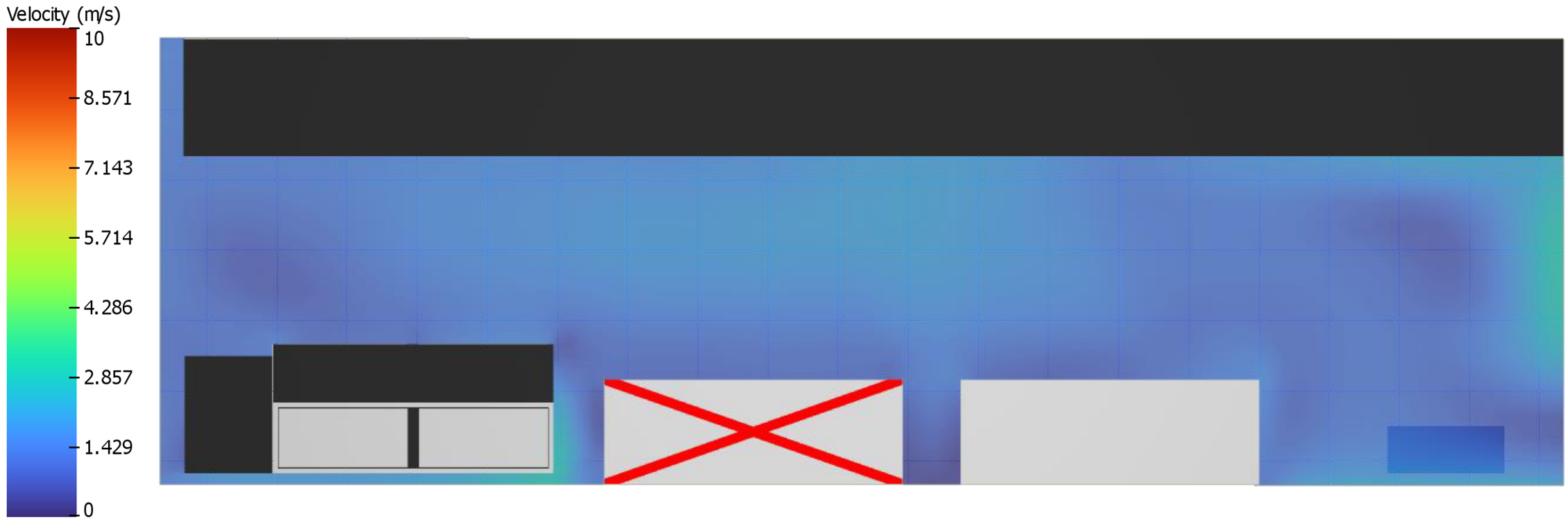
	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
RCU-1	33,1	-1,9	The mean inlet temperature is less than 35°C
RCU-2	33,2	-1,8	The mean inlet temperature is less than 35°C

The mean temperature inside the room is 34,9°C

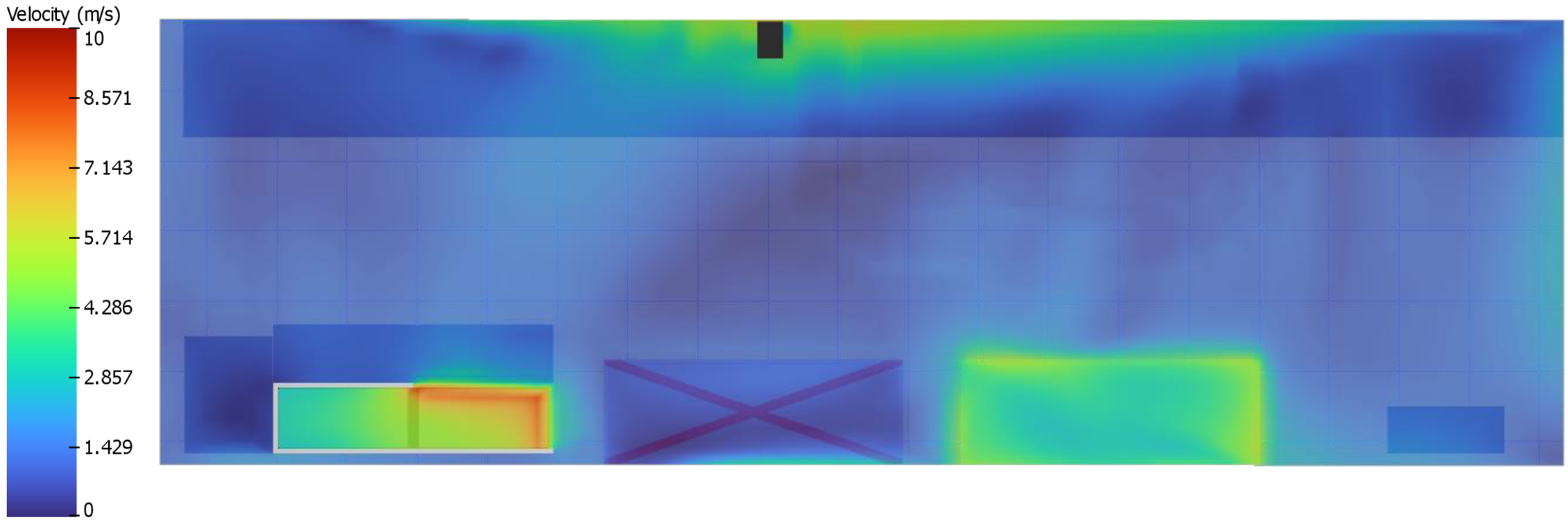
Velocity plot at 1 meter of height



Velocity plot at 2 meter of height

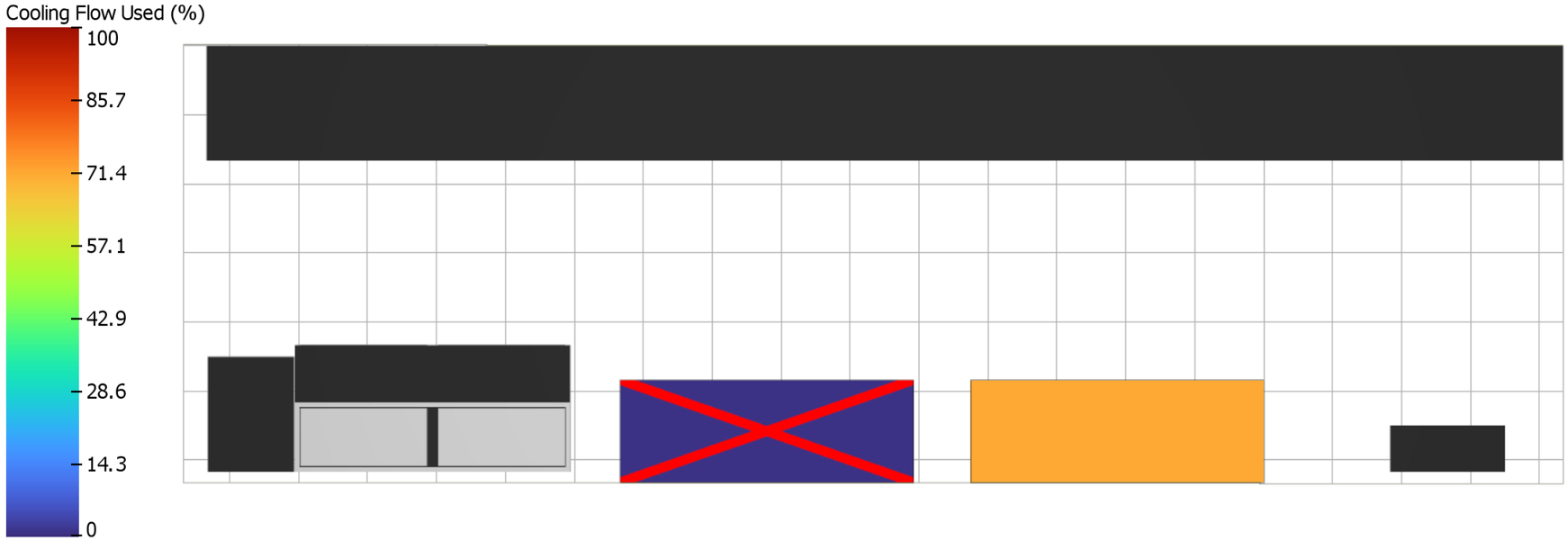


Velocity plot at 3 meter of height

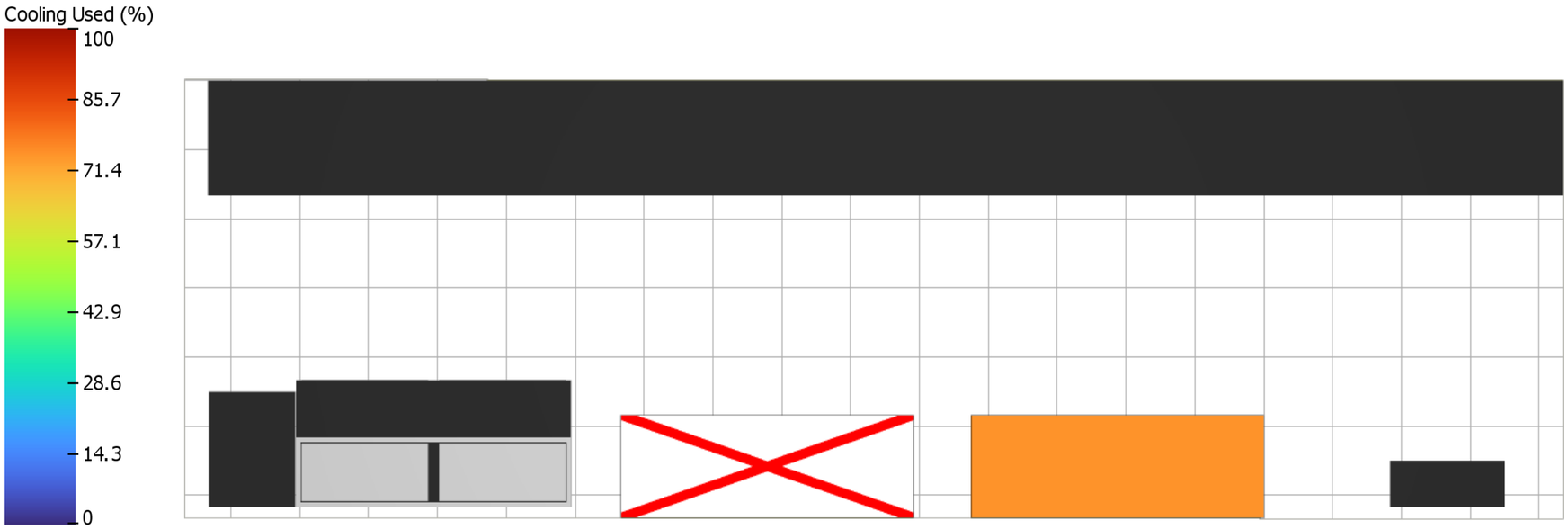


CRAHs airflow and cooling capacity usage

CRAHs airflow usage



CRAHs cooling capacity usage



Operating CRAH data:

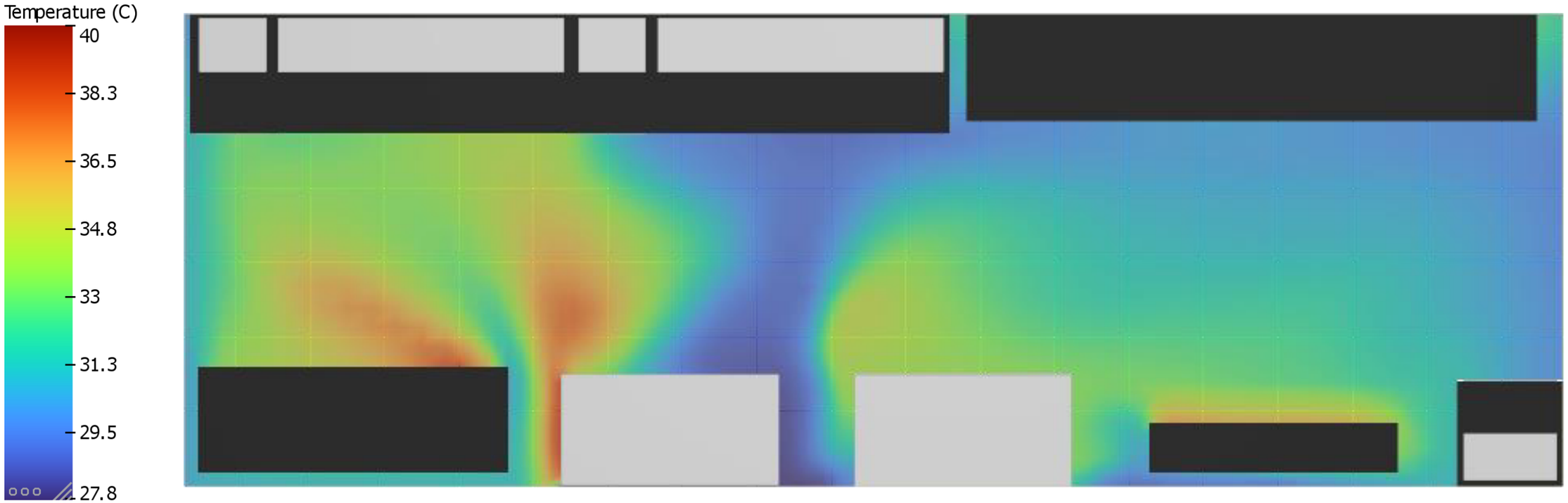
Net Cooling: 78,4 kW
Inrow Flow Rate: 7,0 mc/s

Supply Temperature: 27,8 °C
Return Temperature: 37,1 °C

Results – Case 4 (LV room 2, Normal Operation, Without plenum and cover above UPS and STS units)

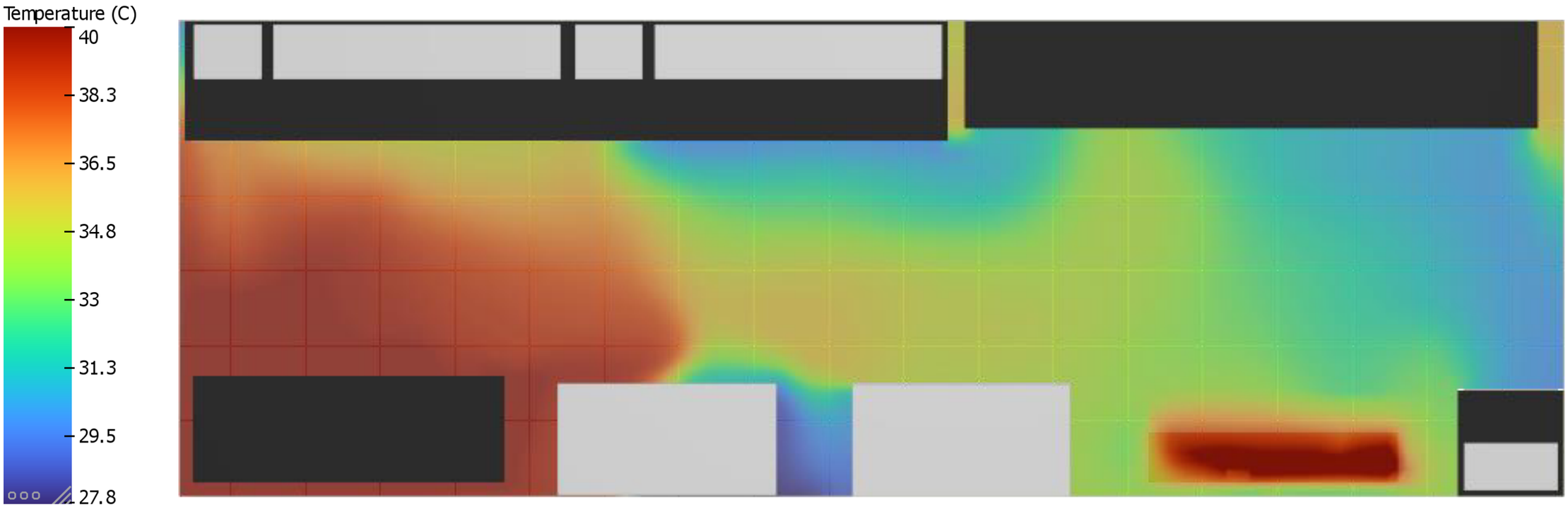
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 31,9°C



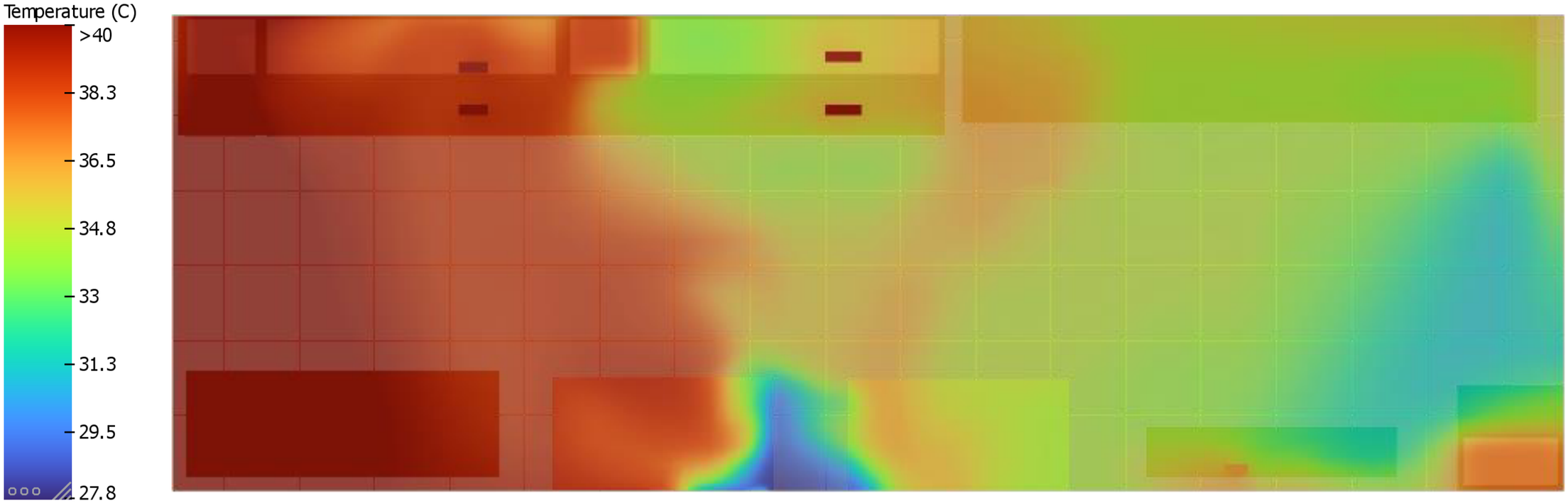
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 35,0°C



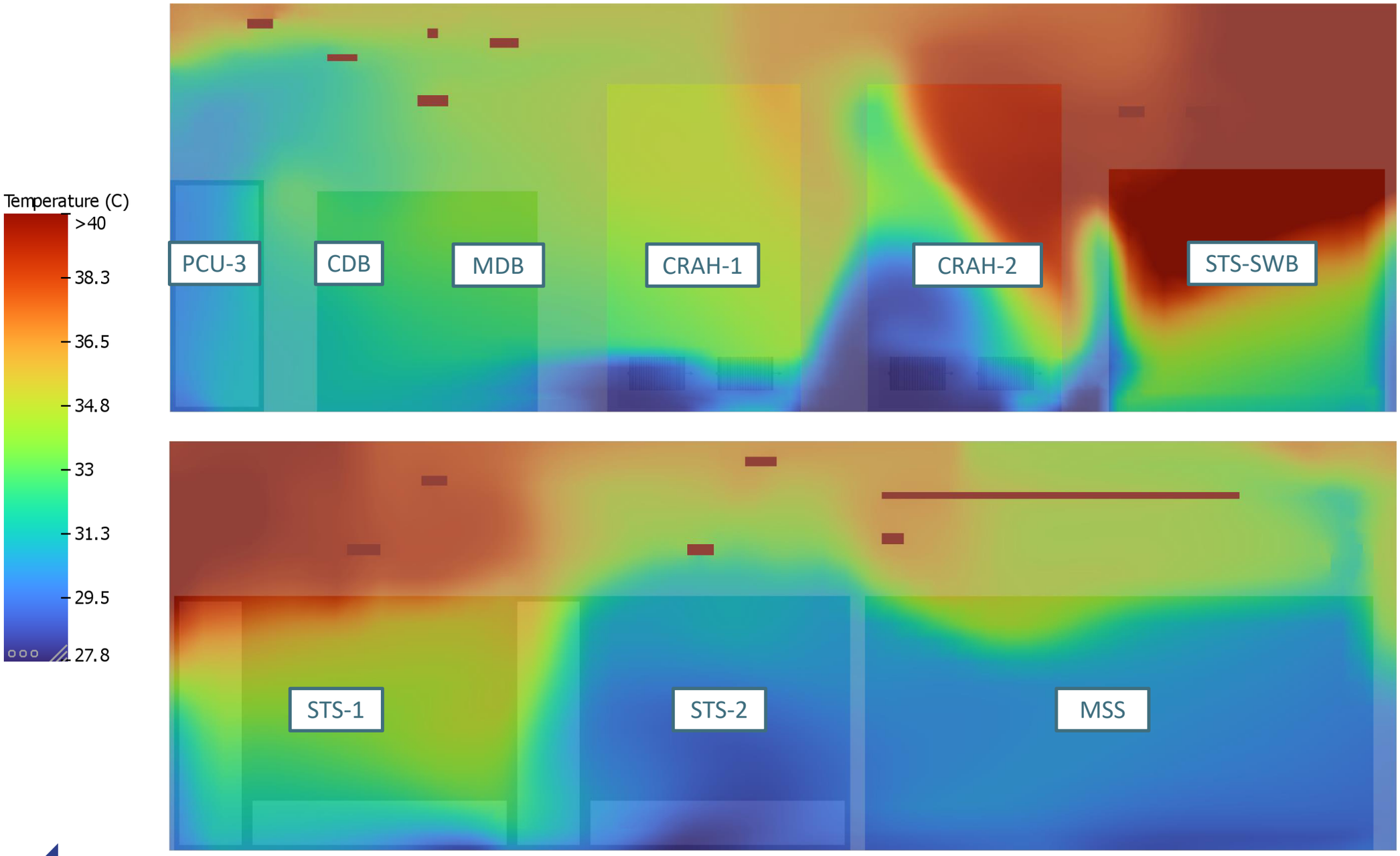
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 36,3°C



Temperature plot at the front of the UPS and electrical panels

The temperature at the front of the STS-SWB is above 40°C.



UPS/STS air inlet temperature and room temperature

STS-1, STS-2 and PCU-3 have the mean inlet temperature below 35°C

	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
STS-1	32,8	-2,2	The mean inlet temperature is less than 35°C
STS-2	31,2	-3,8	The mean inlet temperature is less than 35°C
PCU-3	30,5	-4,5	The mean inlet temperature is less than 35°C

The mean temperature inside the room is 34,4°C

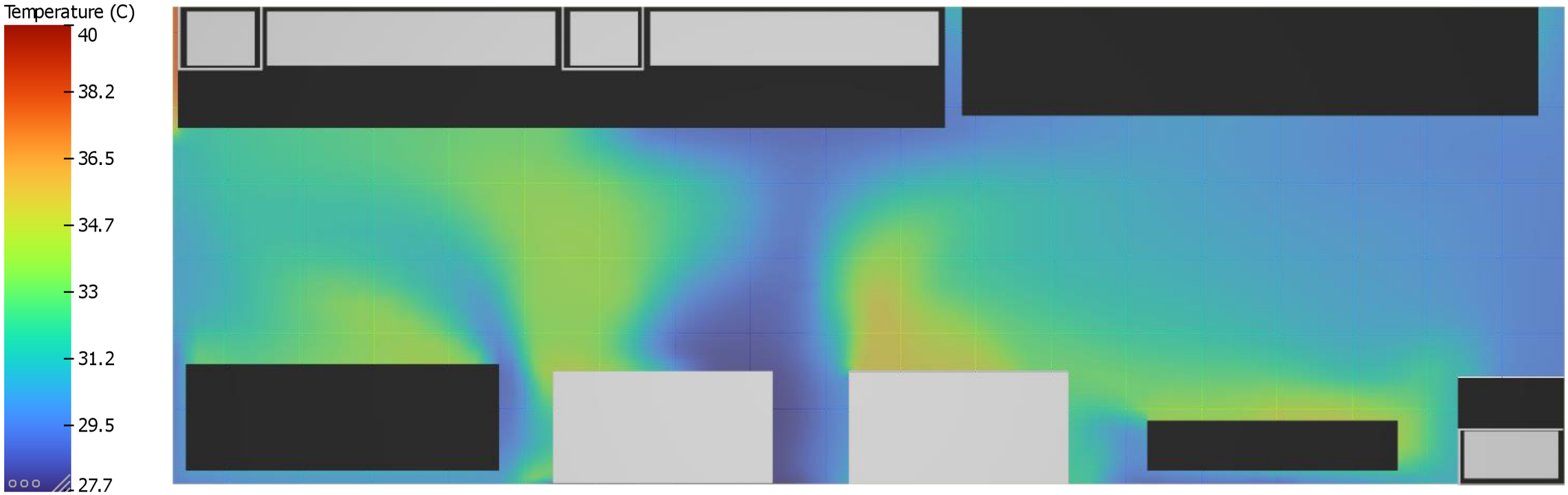
As indicated in the previews slide, due to the hot air coming from the outflows of the STS-1 and STS-2, the temperature at the front of STS-SWB does not meet the verification.

A possible measure to reduce these temperatures is to install a plenum at the air outlets of the STS-1 and STS-2 units, along with a cover above STS-SWB. Cases 5 and 6 analyze the cooling performance of LV Room 2 with the implementation of this plenum and cover.

Results – Case 5 (LV room 2, Normal Operation, with plenum and cover above UPS and STS units)

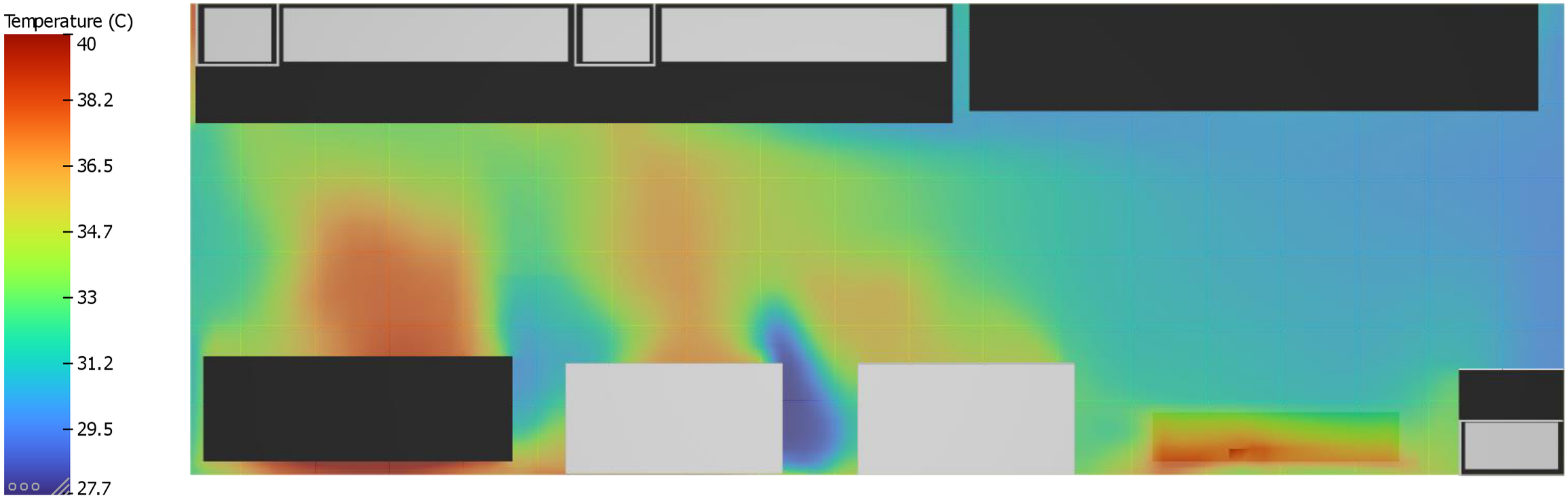
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 30,9°C



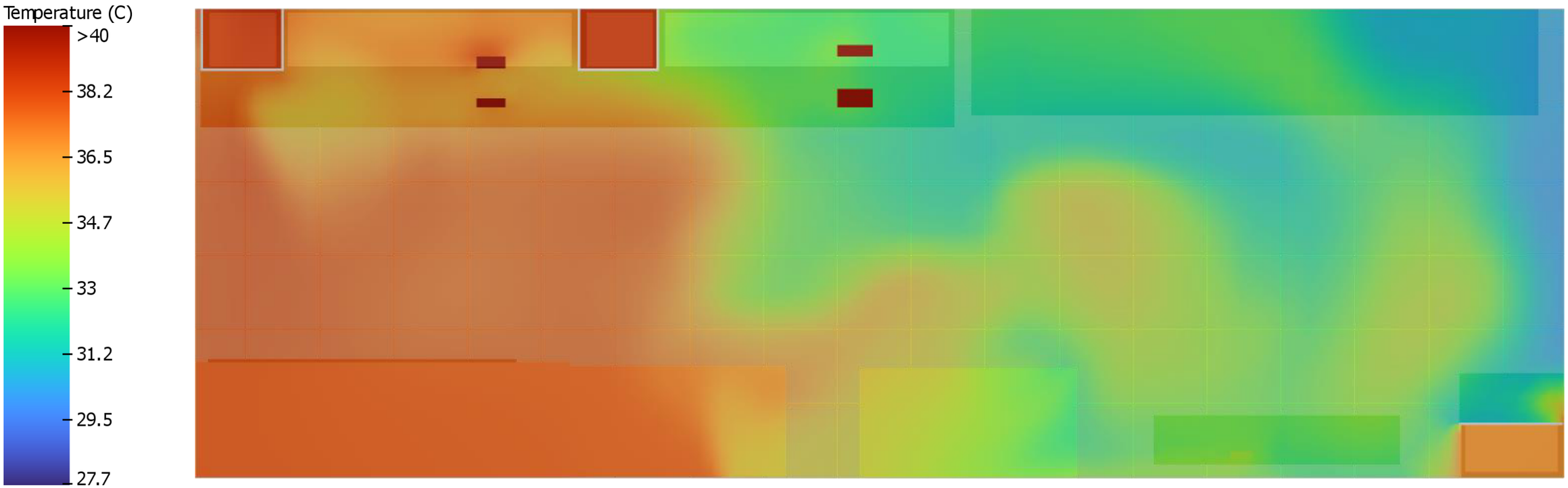
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 33,4°C



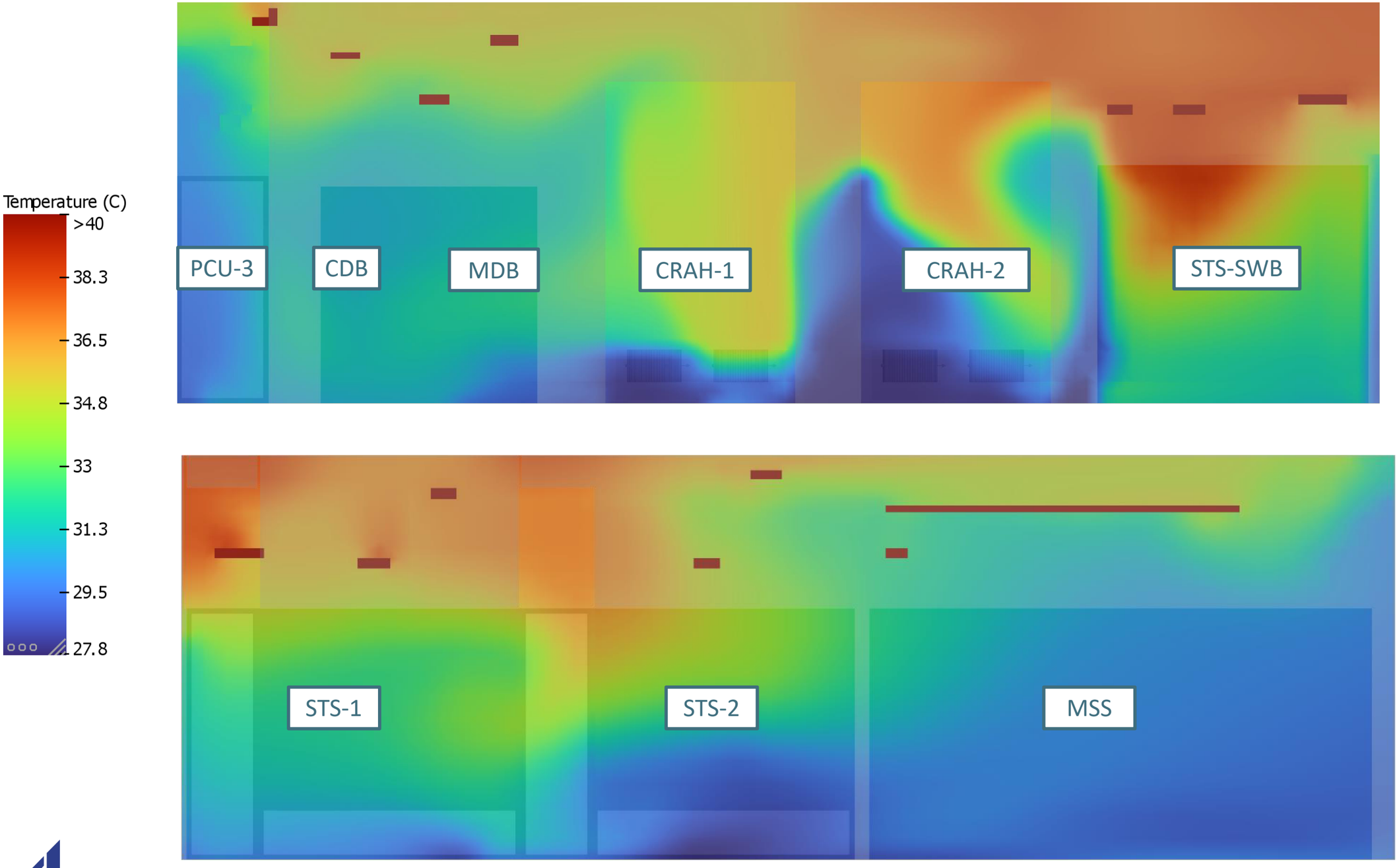
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 35,8°C



Temperature plot at the air inlets of the UPS and STS units

The temperatures at the front of the UPS units and electrical panels are below 40°C.



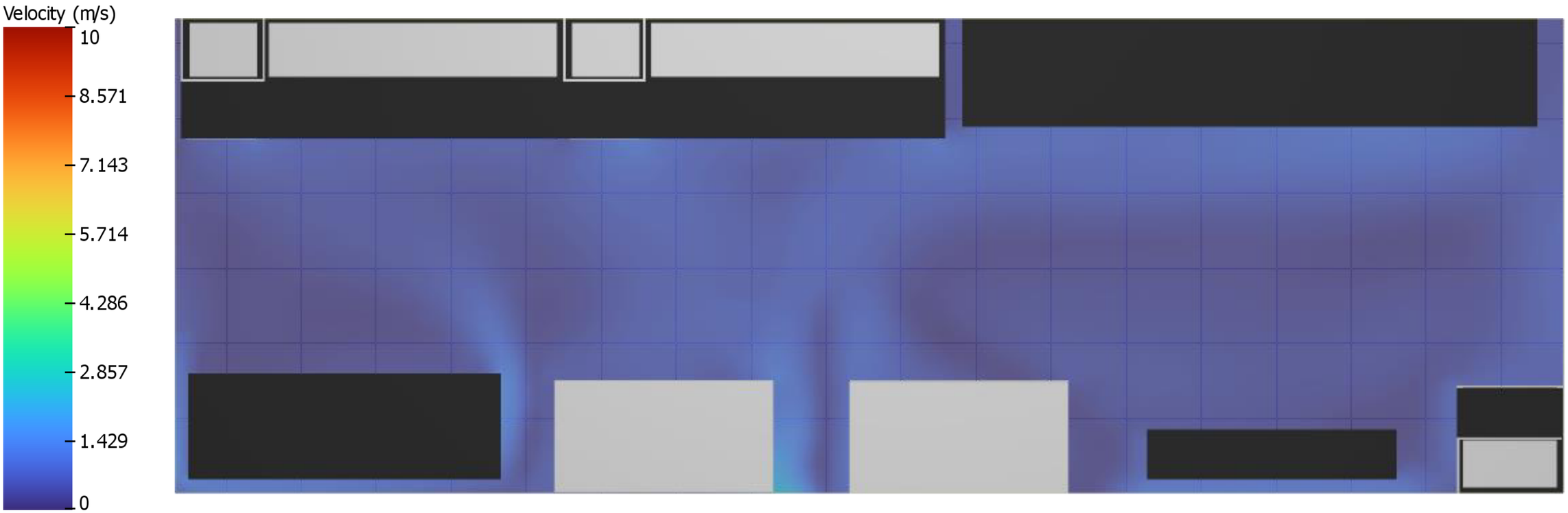
Temperature plot at the air inlets of the UPS and STS units

STS-1, STS-2 and PCU-3 have the mean inlet temperature below 35°C

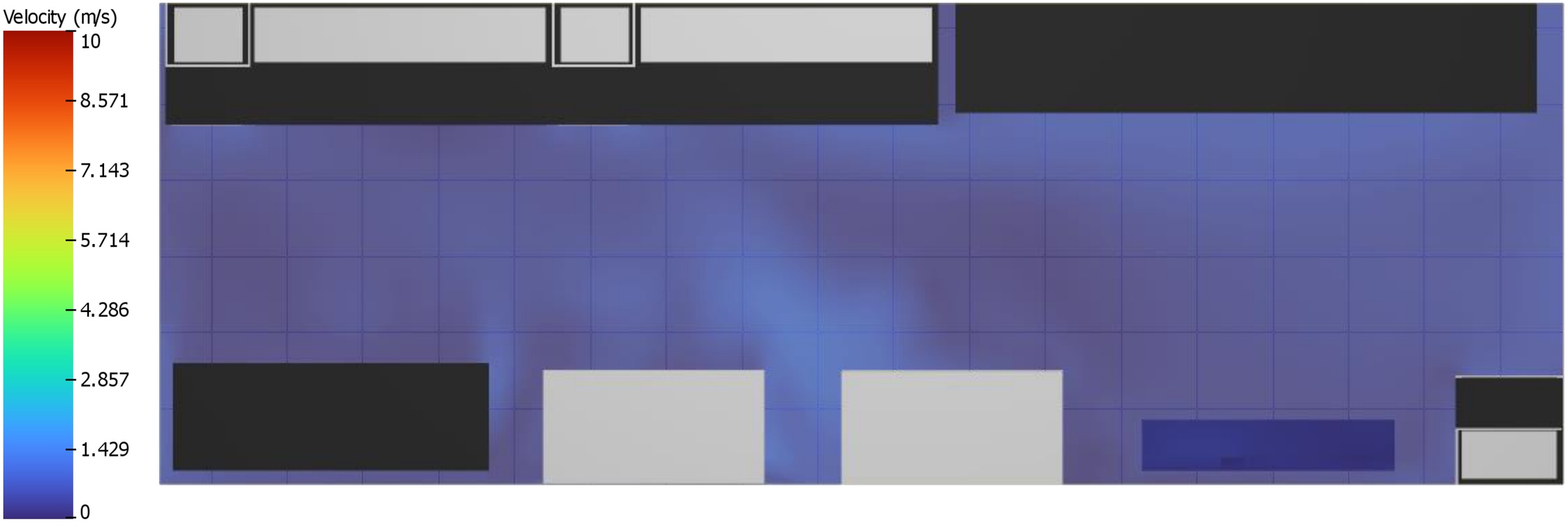
	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
STS-1	31,5	-3,5	The mean inlet temperature is less than 35°C
STS-2	31,0	-4,0	The mean inlet temperature is less than 35°C
PCU-3	30,0	-5,0	The mean inlet temperature is less than 35°C

The mean temperature inside the room is 33,2°C

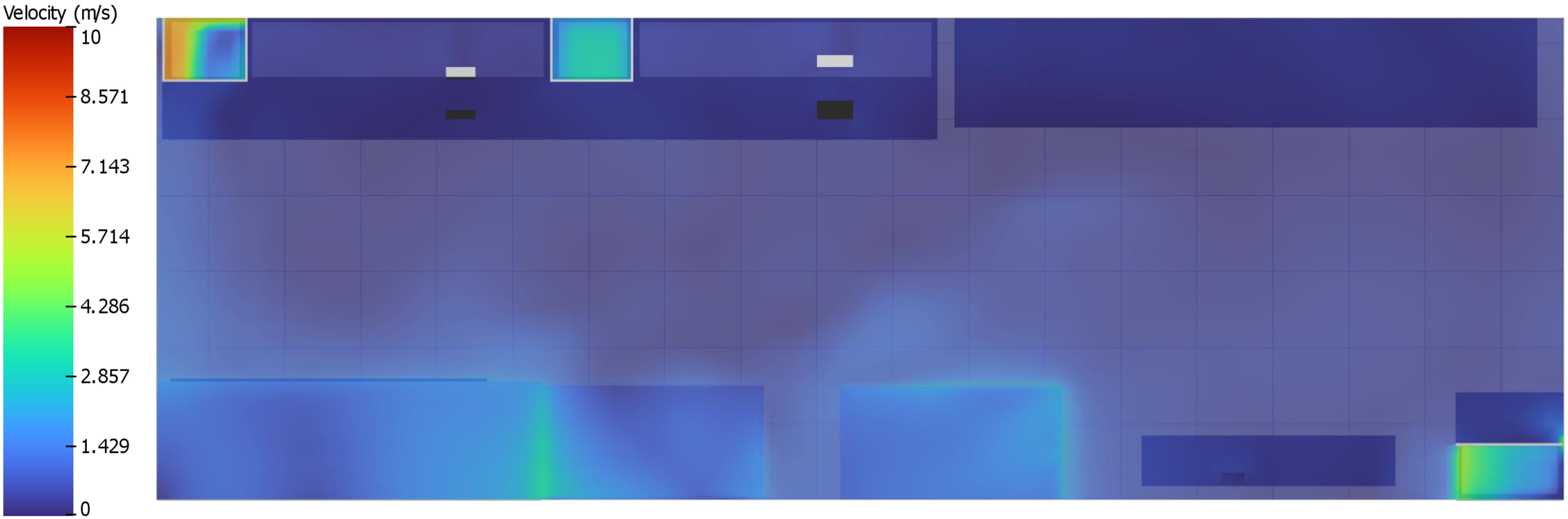
Velocity plot at 1 meter of height



Velocity plot at 2 meter of height

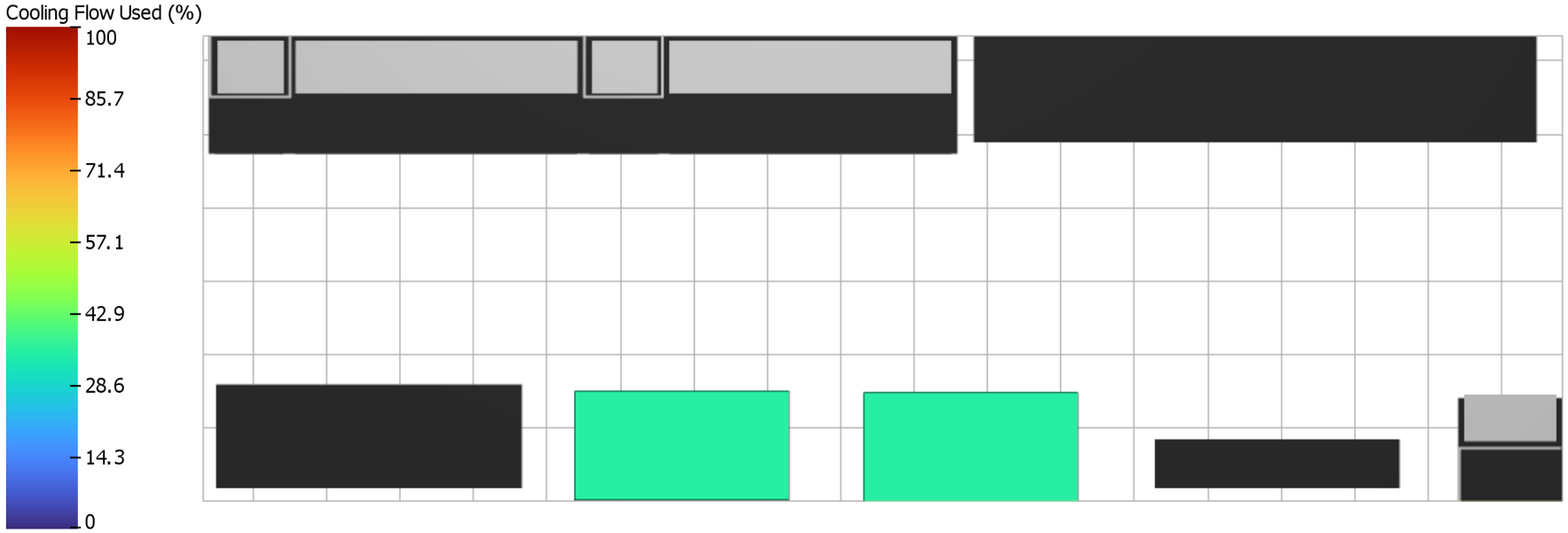


Velocity plot at 3 meter of height

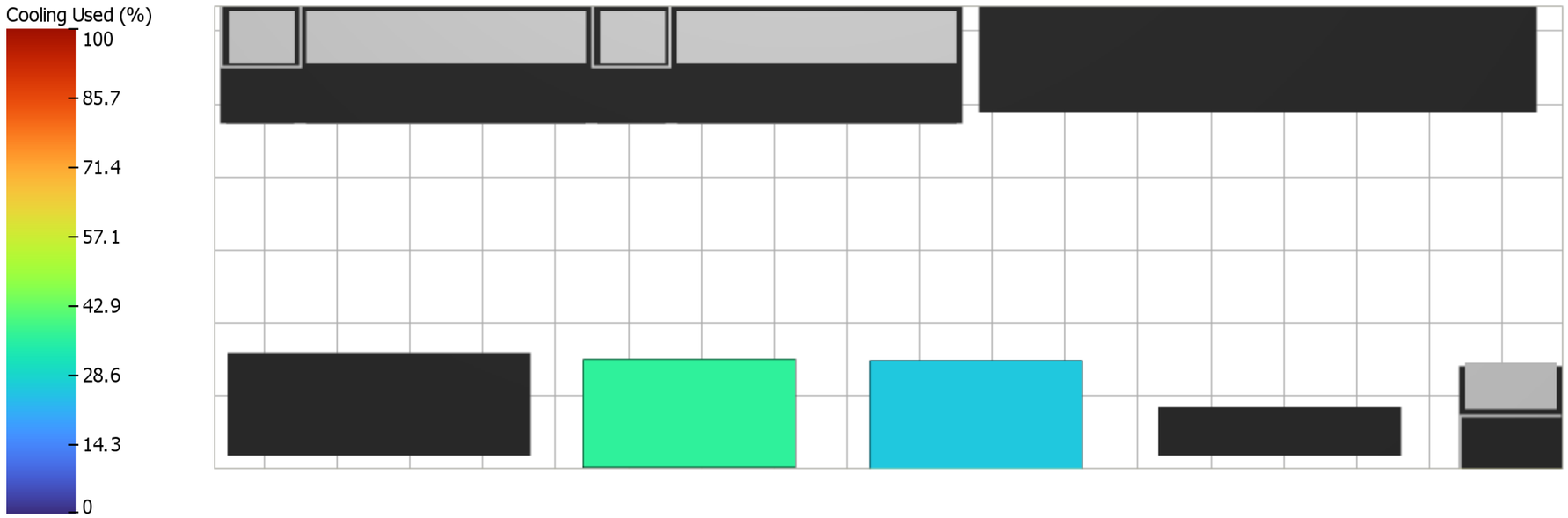


CRAHs airflow and cooling capacity usage

CRAHs airflow usage



CRAHs cooling capacity usage



Operating CRAHs datas:

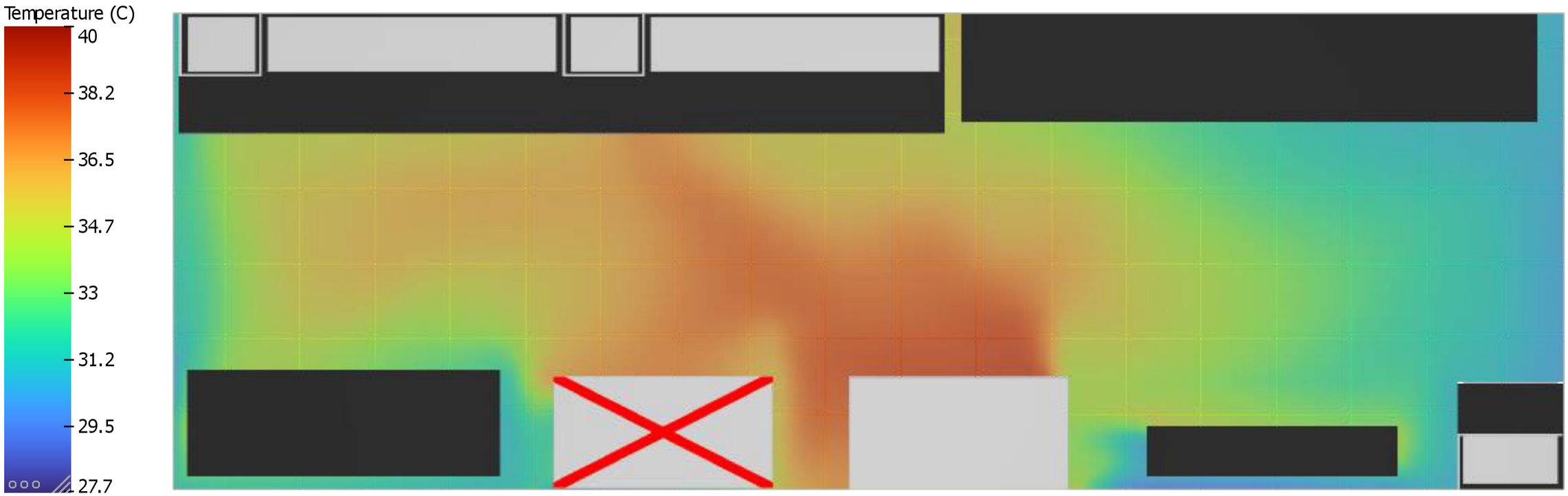
Average Net Cooling: 15,6 kW
Average Inrow Flow Rate: 1,64 mc/s

Average Supply Temperature: 15,6 °C
Average Return Temperature: 35,7 °C

Results – Case 6 (LV room 2, Failure Operation, with plenum and cover above UPS and STS units)

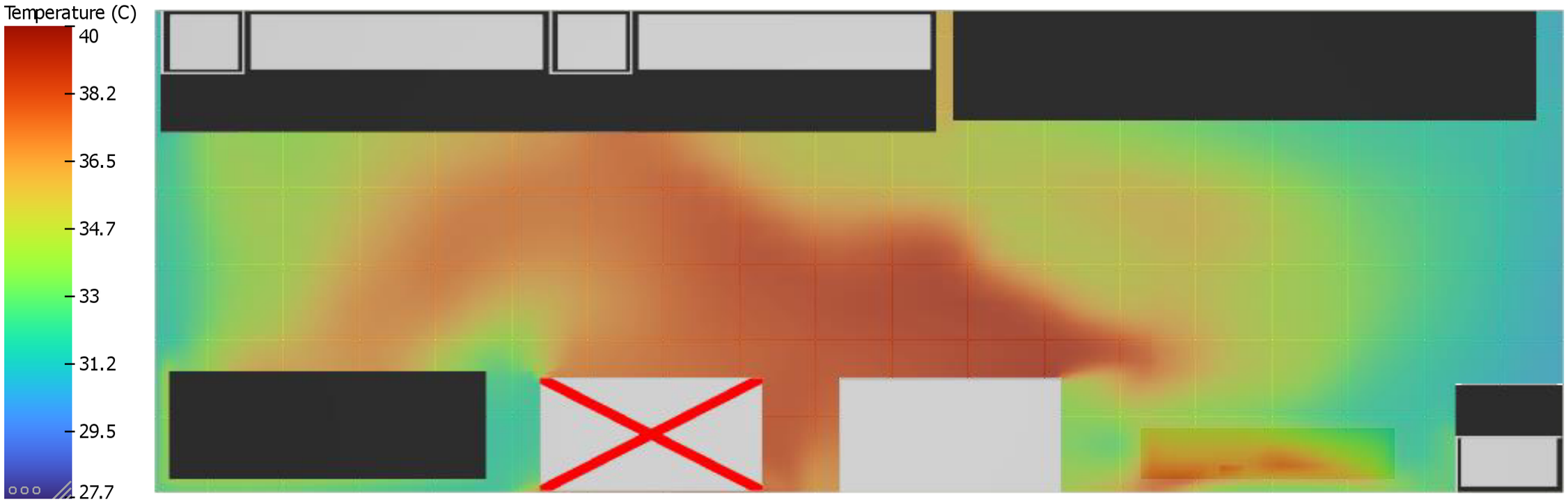
Temperature plot at 1 meter of height

Mean temperature at 1 meter: 34,6°C



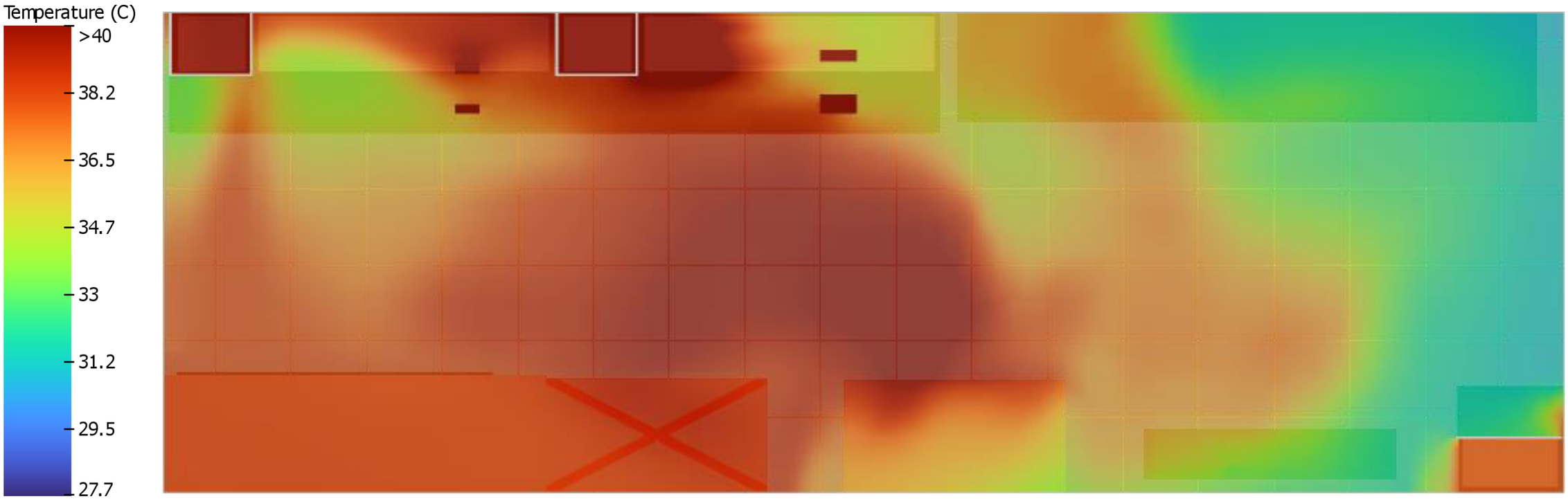
Temperature plot at 2 meter of height

Mean temperature at 2 meter: 36,1°C



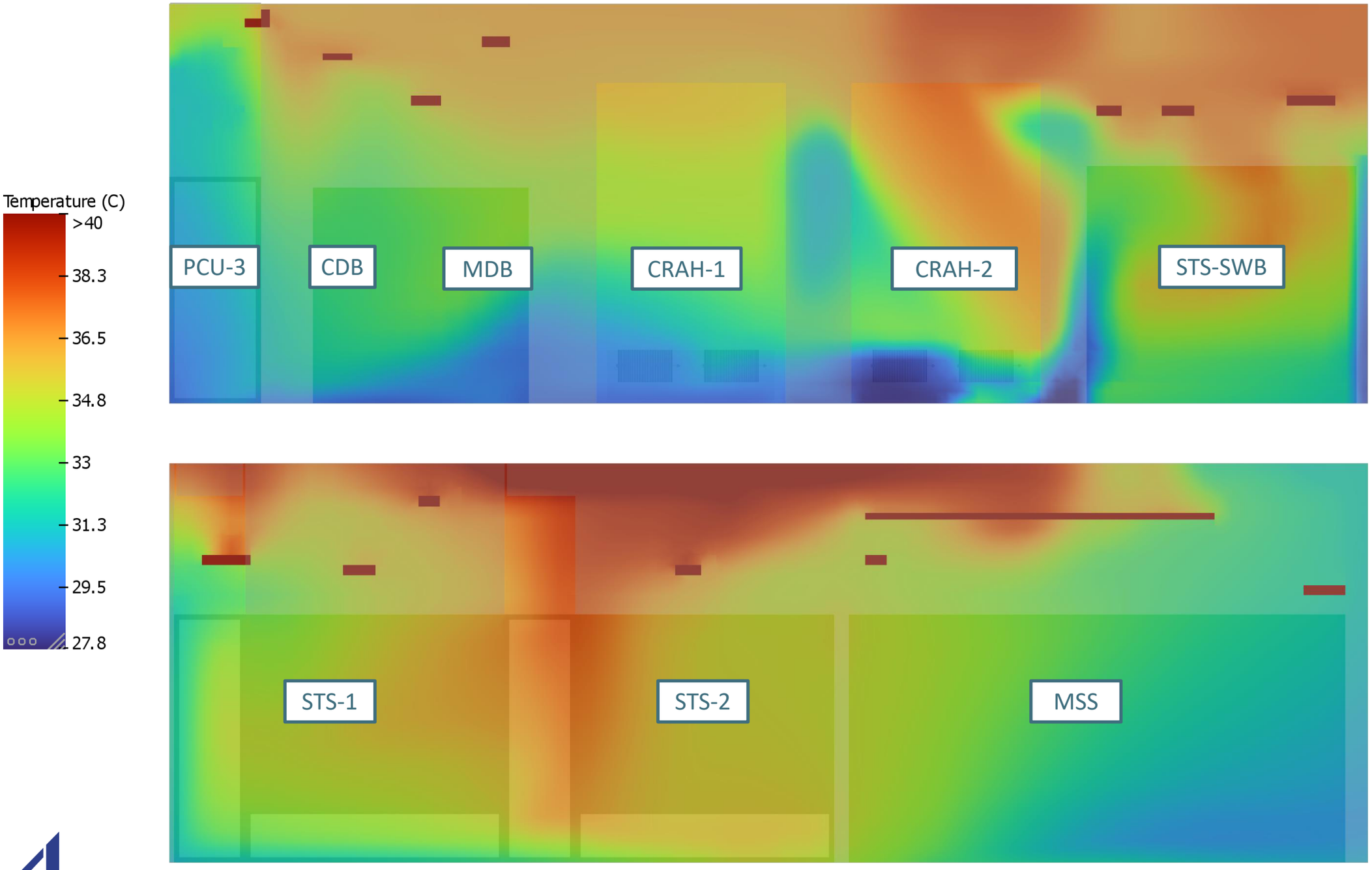
Temperature plot at 3 meter of height

Mean temperature at 3 meter: 37,2°C



Temperature plot at the air inlets of the UPS and STS units

The temperatures at the front of the UPS units and electrical panels are below 40°C.



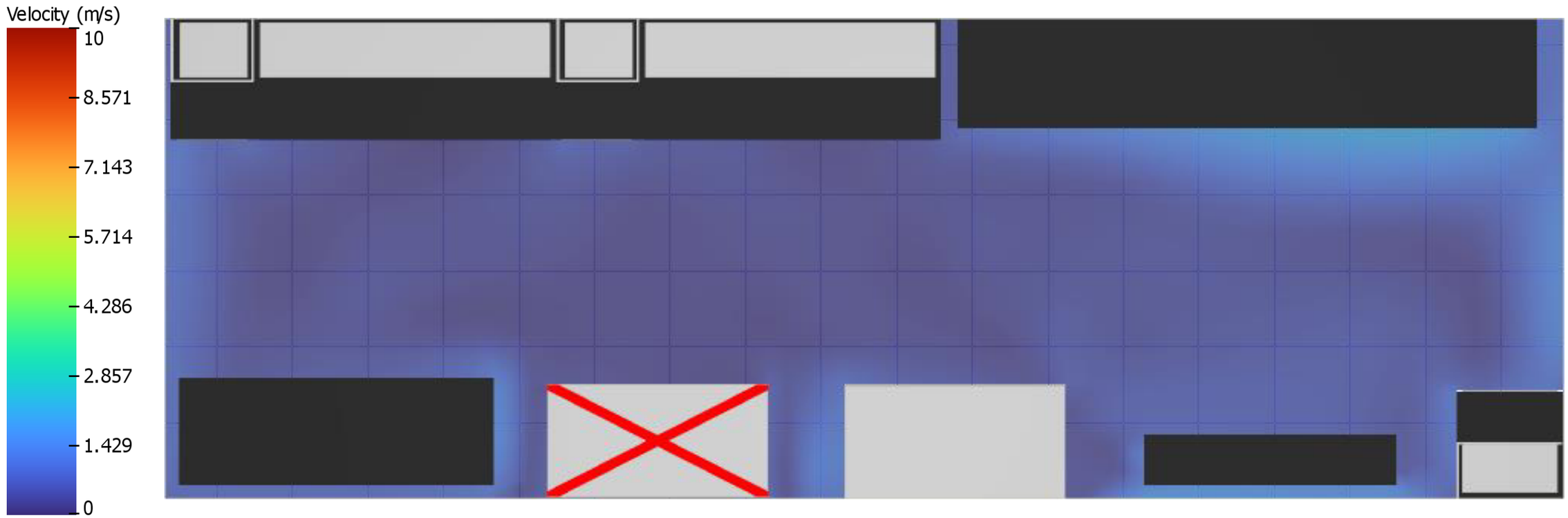
Temperature plot at the air inlets of the UPS and STS units

All the UPS units have the mean inlet temperature below 35°C

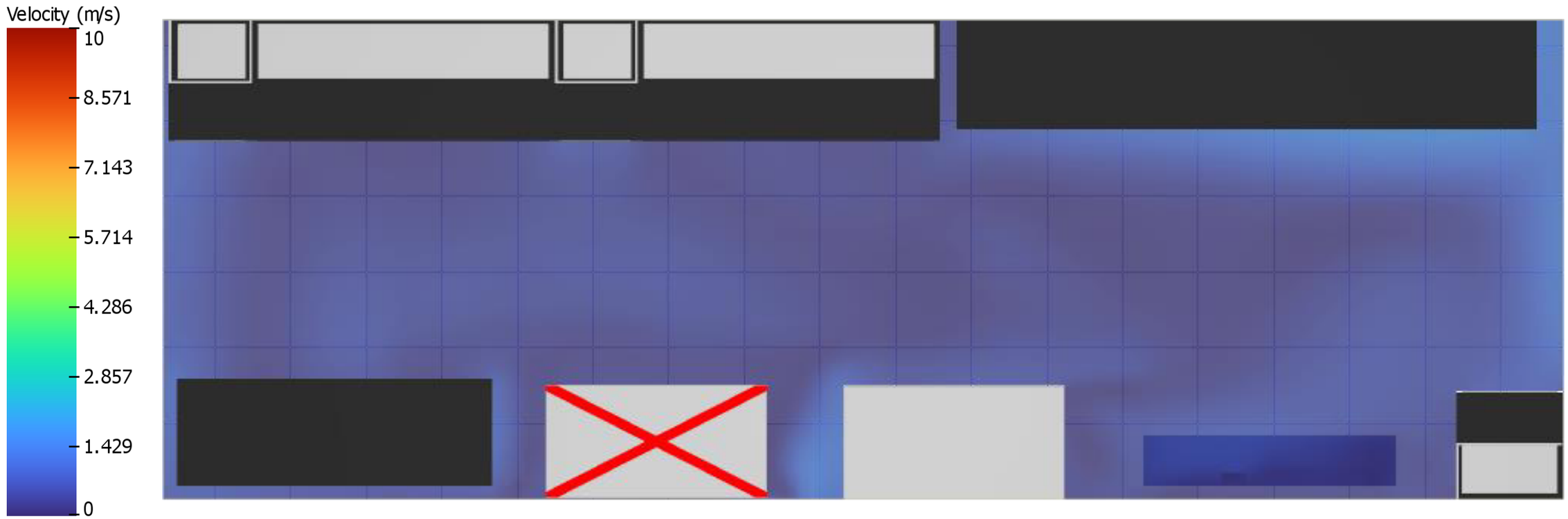
	Mean inlet temperature (°C)	Delta T (°C) (Verification temperature – Mean inlet temperature)	
STS-1	32,3	-3,5	The mean inlet temperature is less than 35°C
STS-2	36,0	+1,0	The mean inlet temperature is above 35°C but is below the limit temperature of 40°C.
PCU-3	30,9	-4,1	The mean inlet temperature is less than 35°C

The mean temperature inside the room is 35,7°C

Velocity plot at 1 meter of height



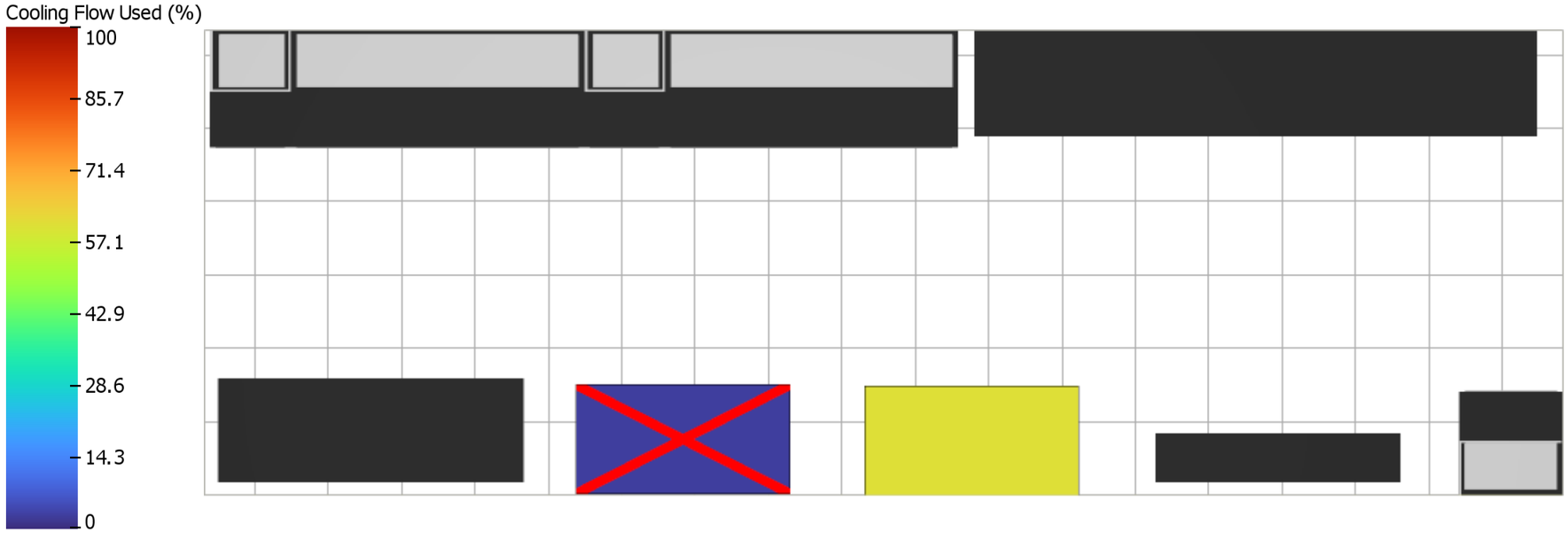
Velocity plot at 2 meter of height



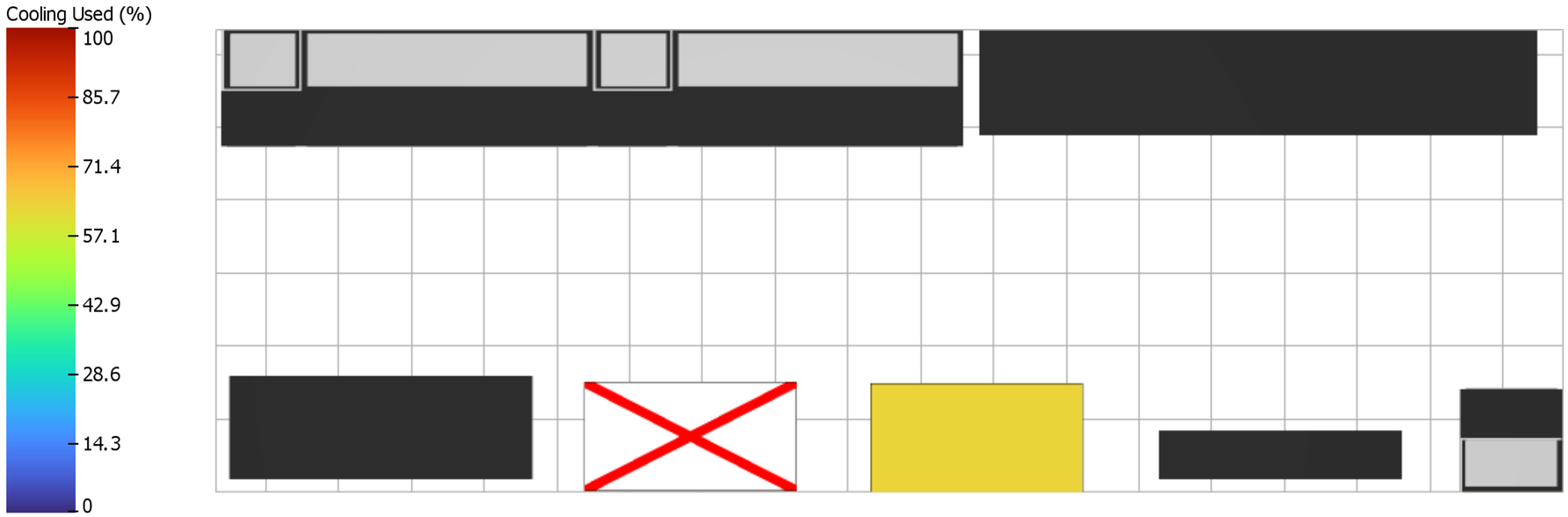
Velocity plot at 3 meter of height

CRAHs airflow and cooling capacity usage

CRAHs airflow usage



CRAHs cooling capacity usage



Operating CRAHs datas:

Net Cooling: 31,5 kW
Inrow Flow Rate: 2,8 mc/s

Supply Temperature: 27,7 °C
Return Temperature: 37,1 °C

Conclusions

Conclusions

LV room 1 conclusions:

As shown in Case 1, during normal operation without the plenum installed above PCU-1 and PCU-2, the mean inlet temperature of PCU-2 exceeds 35°C. Furthermore the temperature at the front of PLI-1 and LBB is above 40°C.

As indicated in Cases 2 and 3, with the addition of the plenum, during normal and failure operation, the mean inlet temperatures of the UPS units remain below 35°C and the temperature at the front of the electrical panels are always below 40°C.

Therefore, a possible solution to reduce the temperature and ensure that LV Room 1 meets the verification criteria during both normal and failure operation is to install a plenum at the air outlets of the UPS units.

Whit the plenum above the UPSs units during normal operation the mean temperature of the room is 34,4°C, while in failure operation is 34,9°C.

Conclusions

LV room 2 conclusions:

As shown in Case 4, during normal operation without a plenum at the air outlets of the STS-1 and STS-2 units and without a cover above STS-SWB, the temperature at the front of STS-SWB does not meet the verification criteria.

As indicated in Case 5 and Case 6, with the installation of a plenum at the air outlets of STS-1 and STS-2 and a cover above STS-SWB, during normal operation, the inlet temperatures of the UPS units remain below 35°C and the temperatures at the front of the electrical panels remain below 40°C. During failure operation, the temperatures at the front of the electrical panels are always below 40°C, the inlet temperatures of PCU-3 and STS-1 are below 35°C, while STS-2 have a mean inlet temperature above 35°C, but below the limit temperature of 40°C.

Therefore, a possible solution to reduce the temperature and to guarantee that LV room 2 shall be able to meet the verification during normal and failure operation is to install a plenum at the air outlets of STS-1 and STS-2 and a cover above STS-SWB.

As shown in case 5 and case 6, during normal operation the mean temperature of the room is 33,2°C, while in failure operation is 35,7°C.

As shown in the cases analyzed, plenums and cover are possible measure that can be implemented by the vendor of the container in order to guarantee that LV room 1 and LV room 2 are able to meet the verification.
The final CFD analysis and the definition of the final layout shall be the responsibility of the container vendor.

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-50002

13038001

Title:

Calculation
Heat Loads
Critical Spaces

PD0 - RIBA 3	**ITM**	**50002**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Heat Loads - Critical Spaces
Document ID	MIL07-DBA-ZZ-XX-CA-M-50002
Date	7-11-2025
Revision	P01

Data Hall 01

Description	[Value]	[UM]	Remarks
Room data			
Area	1600	m2	
Internal height	4,4	m	
Volume	7040	m3	
Ambient loads			
Walls transmission	1	kW	See floowing attached calculation
Roof transmission	3,2	kW	See floowing attached calculation
Corridors partition transmission	3,4	kW	See floowing attached calculation
Total ambient loads	**7,6**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	8,0	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
Total general internal loads	**8,2**	**kW**	
Electrical distribution loads			
General busbar feeds load/m	413	W/m	
General busbar feeds total lenght	130,0	m	
Simultaneity ratio	50%	[-]	
Total general busbar feeds load	26,8	kW	
Row busbar feeds load/m	190	W/m	
Row busbar feeds total lenght	720	m	
Simultaneity ratio	50%	[-]	
Total row busbar feeds load	68,4	kW	
Total electrical distribution loads	**95,2**	**kW**	
Summary			
Room ambient loads	7,6	kW	
General internal loads	8,2	kW	
Electrical distribution loads	95,2	kW	
Total room required cooling capacity	**111,0**	**kW**	

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Heat Loads - Critical Spaces
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Date	7-11-2025
Revision	P01

Data Hall 02

Description	[Value]	[UM]	Remarks
Room data			
Area	1600	m2	
Internal height	4,4	m	
Volume	7040	m3	
Ambient loads			
Walls transmission	1	kW	See floowing attached calculation
Roof transmission	3,2	kW	See floowing attached calculation
Corridors partition transmission	3,4	kW	See floowing attached calculation
Total ambient loads	**7,6**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	8,0	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
Total general internal loads	**8,2**	**kW**	
Electrical distribution loads			
General busbar feeds load/m	413	W/m	
General busbar feeds total lenght	130,0	m	
Simultaneity ratio	50%	[-]	
Total general busbar feeds load	26,8	kW	
Row busbar feeds load/m	190	W/m	
Row busbar feeds total lenght	720	m	
Simultaneity ratio	50%	[-]	
Total row busbar feeds load	68,4	kW	
Total electrical distribution loads	**95,2**	**kW**	
Summary			
Room ambient loads	7,6	kW	
General internal loads	8,2	kW	
Electrical distribution loads	95,2	kW	
Total room required cooling capacity	**111,0**	**kW**	

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Heat Loads - Critical Spaces
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Date	7-11-2025
Revision	P01

Electrical Pod Critical Powerblock (1A, 1B, 1C, 2A, 2B, 2C) LV1

Description	[Value]	[UM]	Remarks
Room data			
Area	45,6	m2	
Internal height	3,2	m	
Volume	146	m3	
Ambient loads			
Walls transmission	0,5	kW	See floowing attached calculation
Roof transmission	0,4	kW	See floowing attached calculation
Loss by infiltration	0,2	kW	See floowing attached calculation
Total ambient loads	**1,1**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	0,2	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
CRAH gross load	2,8	kW	
N° of CRAH units	2	[-]	
Total CRAH units gross load	5,6	kW	
Total general internal loads	**6,0**	**kW**	
Electrical equipments loads			
BMS control panel load	1,0	kW	
N° of BMS control panels	1	[-]	
Simultaneity ratio	80%	[-]	
Total BMS control panels load	0,8	kW	
LV switchgears load	5,0	kW	
Simultaneity ratio	100%	[-]	
Total LV switchgears load	5,0	kW	
IT UPS load	1000	kW	
N° of IT UPS	2	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	100%	[-]	
Total IT UPS load	64,0	kW	
Mech UPS load	0	kW	
N° of mech UPS	0	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	80%	[-]	
Total mech UPS load	0,0	kW	
Total electrical equipments loads	**69,8**	**kW**	
Electrical distribution loads			
LV busbar feeds load	16,0	kW	
Simultaneity ratio	100%	[-]	
Total LV busbar feeds load	16,0	kW	
LV cabling high power load	4,0	kW	
Simultaneity ratio	100%	[-]	
Total LV cabling high power load	4,0	kW	
Total electrical distribution loads	**20,0**	**kW**	
Summary			
Room ambient loads	1,1	kW	
General internal loads	6,0	kW	
Electrical equipments loads	69,8	kW	
Electrical distribution loads	20,0	kW	
Total room required cooling capacity	**96,9**	**kW**	

Client:	STACK INFRASTRUCTURE
Project	MIL07
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Revision	P01

Electrical Pod Critical Powerblock (1A, 1B, 1C, 2A, 2B, 2C) LV2

Description	[Value]	[UM]	Remarks
Room data			
Area	42,1	m2	
Internal height	3,2	m	
Volume	135	m3	
Ambient loads			
Walls transmission	0,3	kW	See floowing attached calculation
Roof transmission	0,4	kW	See floowing attached calculation
Loss by infiltration	0,2	kW	See floowing attached calculation
Total ambient loads	**0,9**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	0,2	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
CRAH gross load	1,0	kW	
N° of CRAH units	2	[-]	
Total CRAH units gross load	2,0	kW	
Total general internal loads	**2,4**	**kW**	
Electrical equipments loads			
BMS control panel load	0,0	kW	
N° of BMS control panels	0	[-]	
Simultaneity ratio	80%	[-]	
Total BMS control panels load	0,0	kW	
LV switchgears load	19,0	kW	
Simultaneity ratio	100%	[-]	
Total LV switchgears load	19,0	kW	
IT UPS load	0	kW	
N° of IT UPS	0	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	100%	[-]	
Total IT UPS load	0,0	kW	
Mech UPS load	300	kW	
N° of mech UPS	1	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	80%	[-]	
Total mech UPS load	7,7	kW	
Total electrical equipments loads	**26,7**	**kW**	
Electrical distribution loads			
LV busbar feeds load	11,0	kW	
Simultaneity ratio	100%	[-]	
Total LV busbar feeds load	11,0	kW	
LV cabling high power load	3,0	kW	
Simultaneity ratio	100%	[-]	
Total LV cabling high power load	3,0	kW	
Total electrical distribution loads	**14,0**	**kW**	
Summary			
Room ambient loads	0,9	kW	
General internal loads	2,4	kW	
Electrical equipments loads	26,7	kW	
Electrical distribution loads	14,0	kW	
Total room required cooling capacity	**44,0**	**kW**	

Client:	STACK INFRASTRUCTURE
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Document ID	MIL07-DBA-ZZ-XX-CA-M-50002
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Revision	P01

Electrical Pod R1 LV1

Description	[Value]	[UM]	Remarks
Room data			
Area	45,6	m2	
Internal height	3,2	m	
Volume	146	m3	
Ambient loads			
Walls transmission	0,5	kW	See floowing attached calculation
Roof transmission	0,4	kW	See floowing attached calculation
Loss by infiltration	0,2	kW	See floowing attached calculation
Total ambient loads	**1,1**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	0,2	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
CRAH gross load	2,8	kW	
N° of CRAH units	2	[-]	
Total CRAH units gross load	5,6	kW	
Total general internal loads	**6,0**	**kW**	
Electrical equipments loads			
BMS control panel load	1,0	kW	
N° of BMS control panels	1	[-]	
Simultaneity ratio	80%	[-]	
Total BMS control panels load	0,8	kW	
LV switchgears load	5,0	kW	
Simultaneity ratio	100%	[-]	
Total LV switchgears load	5,0	kW	
IT UPS load	1000	kW	
N° of IT UPS	2	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	100%	[-]	
Total IT UPS load	64,0	kW	
Mech UPS load	0	kW	
N° of mech UPS	0	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	80%	[-]	
Total mech UPS load	0,0	kW	
Total electrical equipments loads	**69,8**	**kW**	
Electrical distribution loads			
LV busbar feeds load	16,0	kW	
Simultaneity ratio	100%	[-]	
Total LV busbar feeds load	16,0	kW	
LV cabling high power load	4,0	kW	
Simultaneity ratio	100%	[-]	
Total LV cabling high power load	4,0	kW	
Total electrical distribution loads	**20,0**	**kW**	
Summary			
Room ambient loads	1,1	kW	
General internal loads	6,0	kW	
Electrical equipments loads	69,8	kW	
Electrical distribution loads	20,0	kW	
Total room required cooling capacity	**96,9**	**kW**	

Client:	STACK INFRASTRUCTURE
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Document ID	MIL07-DBA-ZZ-XX-CA-M-50002
Date	7-11-2025
Revision	P01

Electrical Pod R1 LV2

Description	[Value]	[UM]	Remarks
Room data			
Area	42,1	m2	
Internal height	3,2	m	
Volume	135	m3	
Ambient loads			
Walls transmission	0,3	kW	See floowing attached calculation
Roof transmission	0,4	kW	See floowing attached calculation
Loss by infiltration	0,2	kW	See floowing attached calculation
Total ambient loads	**0,9**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	0,2	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
CRAH gross load	0,7	kW	
N° of CRAH units	2	[-]	
Total CRAH units gross load	1,4	kW	
Total general internal loads	**1,8**	**kW**	
Electrical equipments loads			
BMS control panel load	0,0	kW	
N° of BMS control panels	0	[-]	
Simultaneity ratio	80%	[-]	
Total BMS control panels load	0,0	kW	
LV switchgears load	0,7	kW	
Simultaneity ratio	100%	[-]	
Total LV switchgears load	0,7	kW	
IT UPS load	0	kW	
N° of IT UPS	0	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	100%	[-]	
Total IT UPS load	0,0	kW	
Mech UPS load	300	kW	
N° of mech UPS	1	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	80%	[-]	
Total mech UPS load	7,7	kW	
Total electrical equipments loads	**8,4**	**kW**	
Electrical distribution loads			
LV busbar feeds load	2,0	kW	
Simultaneity ratio	100%	[-]	
Total LV busbar feeds load	2,0	kW	
LV cabling high power load	3,0	kW	
Simultaneity ratio	100%	[-]	
Total LV cabling high power load	3,0	kW	
Total electrical distribution loads	**5,0**	**kW**	
Summary			
Room ambient loads	0,9	kW	
General internal loads	1,8	kW	
Electrical equipments loads	8,4	kW	
Electrical distribution loads	5,0	kW	
Total room required cooling capacity	**16,1**	**kW**	

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Heat Loads - Critical Spaces
Document ID	MIL07-DBA-ZZ-XX-CA-M-50002
Date	7-11-2025
Revision	P01

Electrical Pod H1 LV1

Description	[Value]	[UM]	Remarks
Room data			
Area	45,6	m2	
Internal height	3,2	m	
Volume	146	m3	
Ambient loads			
Walls transmission	0,5	kW	See floowing attached calculation
Roof transmission	0,4	kW	See floowing attached calculation
Loss by infiltration	0,2	kW	See floowing attached calculation
Total ambient loads	**1,1**	**kW**	
General internal loads			
Lighting load	5	W/m2	
Total lighting load	0,2	kW	
People occupancy	2	[-]	
People sensible load	87	W	Medium work
Total people load	0,2	kW	
CRAH gross load	0,7	kW	
N° of CRAH units	2	[-]	
Total CRAH units gross load	1,4	kW	
Total general internal loads	**1,8**	**kW**	
Electrical equipments loads			
BMS control panel load	1,0	kW	
N° of BMS control panels	1	[-]	
Simultaneity ratio	80%	[-]	
Total BMS control panels load	0,8	kW	
LV switchgears load	1,8	kW	
Simultaneity ratio	100%	[-]	
Total LV switchgears load	1,8	kW	
IT UPS load	0	kW	
N° of IT UPS	0	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	100%	[-]	
Total IT UPS load	0,0	kW	
Mech UPS load	300	kW	
N° of mech UPS	1	[-]	
UPS losses	3,2%	[-]	
Simultaneity ratio	80%	[-]	
Total mech UPS load	7,7	kW	
Total electrical equipments loads	**10,3**	**kW**	
Electrical distribution loads			
LV busbar feeds load	2,1	kW	
Simultaneity ratio	100%	[-]	
Total LV busbar feeds load	2,1	kW	
LV cabling high power load	1,4	kW	
Simultaneity ratio	100%	[-]	
Total LV cabling high power load	1,4	kW	
Total electrical distribution loads	**3,5**	**kW**	
Summary			
Room ambient loads	1,1	kW	
General internal loads	1,8	kW	
Electrical equipments loads	10,3	kW	
Electrical distribution loads	3,5	kW	
Total room required cooling capacity	**16,7**	**kW**	

Design Weather Parameters & MSHGs

Design Parameters:

City Name	**Milan (Linate)**	
Location	**Italy**	
Latitude	**45,4**	Deg.
Longitude	**9,3**	Deg.
Elevation	**108,0**	m
Summer Design Dry-Bulb	**38,0**	°C
Summer Coincident Wet-Bulb	**28,5**	°C
Summer Daily Range	**10,5**	K
Winter Design Dry-Bulb	**-10,1**	°C
Winter Design Wet-Bulb	**-10,9**	°C
Atmospheric Clearness Number	**1,00**	
Average Ground Reflectance	**0,20**	
Soil Conductivity	**1,385**	W/(m K)
Local Time Zone (GMT +/- N hours)	**1,0**	hours
Consider Daylight Savings Time	**No**	
Simulation Weather Data	**N/A**	
Current Data is	**User Modified**	
Design Cooling Months	**January to December**	

Design Day Maximum Solar Heat Gains

(The MSHG values are expressed in W/m²)

Month	N	NNE	NE	ENE	E	ESE	SE	SSE	S
January	52,1	52,1	52,1	204,5	390,9	595,7	704,0	772,7	785,9
February	67,3	67,3	133,6	343,7	562,2	688,0	776,8	789,8	780,2
March	84,3	84,3	278,7	503,6	642,6	749,1	753,5	721,5	698,6
April	101,5	207,7	422,6	583,6	696,3	705,3	666,2	587,9	556,5
May	113,9	300,3	506,6	631,4	692,7	667,7	587,7	482,8	437,4
June	151,4	340,3	530,9	639,7	683,3	640,4	547,7	431,5	383,6
July	116,4	309,9	498,1	614,5	681,5	646,5	571,3	467,9	424,3
August	106,8	209,6	403,1	569,0	670,3	684,9	640,7	569,7	537,9
September	88,0	88,0	241,8	471,6	618,7	708,7	718,0	689,6	677,1
October	70,1	70,1	117,4	342,8	521,1	676,9	740,5	755,2	758,6
November	53,3	53,3	53,3	180,8	409,5	566,7	703,7	760,3	775,4
December	45,6	45,6	45,6	143,5	324,8	535,7	657,4	742,7	764,7
Month	**SSW**	**SW**	**WSW**	**W**	**WNW**	**NW**	**NNW**	**HOR**	**Mult**
January	768,9	715,6	589,8	416,1	181,8	52,1	52,1	316,1	1,00
February	786,5	769,9	700,5	552,7	360,6	105,4	67,3	476,4	1,00
March	722,1	758,8	734,9	663,7	488,9	289,4	84,3	628,9	1,00
April	592,6	669,2	711,8	693,6	581,7	427,2	194,9	740,8	1,00
May	485,0	588,3	670,5	688,8	636,2	505,0	305,1	799,5	1,00
June	436,1	548,2	645,2	672,9	647,3	524,7	351,4	813,4	1,00
July	473,9	573,8	657,1	668,8	627,5	494,0	312,2	790,3	1,00
August	573,8	646,5	687,0	668,5	562,1	413,9	192,3	728,7	1,00
September	690,4	717,0	709,4	617,4	471,9	244,1	88,0	609,4	1,00
October	762,1	747,8	670,0	535,3	318,6	129,7	70,1	471,7	1,00
November	761,3	699,7	578,0	401,4	195,0	53,3	53,3	317,9	1,00
December	744,0	667,5	529,8	342,9	136,9	45,6	45,6	252,6	1,00

Mult. = User-defined solar multiplier factor.

Space Input Data

DH01 Data Hall

1. General Details:

Floor Area ..... **1600,0** m²
Avg. Ceiling Height ..... **4,4** m
Building Weight ..... **146,5** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **0,0** L/s
OA Requirement 2 ..... **0,0** L/s
Space Usage Defaults ..... **ASHRAE Std 62.1-2013**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Free Hanging**
Wattage ..... **0,00** W/m²
Ballast Multiplier **1,00**
Schedule ..... **None**

2.2. Task Lighting:

Wattage ..... **0,00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **0,0** Watts
Schedule ..... **None**

2.4. People:

Occupancy ..... **0,0** Person
Activity Level ..... **Medium Work**
Sensible ..... **86,5** W/person
Latent ..... **133,3** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NW	456,0	0	0	0

3.1. Construction Types for Exposure NW

Wall Type ..... **External wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	1600,0	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Roof 01**

5. Infiltration:

Design Cooling ..... **0,00** ACH
Design Heating ..... **0,00** ACH
Energy Analysis ..... **0,00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Slab Floor On Grade**
Floor Area ..... **1600,0** m²
Total Floor U-Value ..... **0,350** W/(m²·K)
Exposed Perimeter ..... **80,0** m
Edge Insulation R-Value ..... **1,00** (m²·K)/W

7. Partitions:

7.1. 1st Partition Details:

Partition Type ..... **Wall Partition**
Area ..... **276,0** m²
U-Value ..... **2,561** W/(m²·K)
Uncondit. Space Max Temp ..... **30,0** °C
Ambient at Space Max Temp ..... **29,0** °C
Uncondit. Space Min Temp ..... **10,0** °C
Ambient at Space Min Temp ..... **27,0** °C

7.2. 2nd Partition Details:

(No partition data).

DH02 Data Hall

1. General Details:

Floor Area	**1600,0**	m²
Avg. Ceiling Height	**4,4**	m
Building Weight	**146,5**	kg/m²

1.1. OA Ventilation Requirements:

Space Usage	**User-Defined**	
OA Requirement 1	**0,0**	L/s
OA Requirement 2	**0,0**	L/s
Space Usage Defaults	**ASHRAE Std 62.1-2013**	

2. Internals:

2.1. Overhead Lighting:

Fixture Type	**Free Hanging**	
Wattage	**0,00**	W/m²
Ballast Multiplier	**1,00**	
Schedule	**None**	

2.2. Task Lighting:

Wattage	**0,00**	W/m²
Schedule	**None**	

2.3. Electrical Equipment:

Wattage	**0,0**	Watts
Schedule	**None**	

2.4. People:

Occupancy	**0,0**	Person
Activity Level	**Medium Work**	
Sensible	**86,5**	W/person
Latent	**133,3**	W/person
Schedule	**None**	

2.5. Miscellaneous Loads:

Sensible	**0**	W
Schedule	**None**	
Latent	**0**	W
Schedule	**None**	

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
NW	456,0	0	0	0

3.1. Construction Types for Exposure NW

Wall Type **External wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	1600,0	0	0

4.1. Construction Types for Exposure H

Roof Type **Roof 01**

5. Infiltration:

Design Cooling	**0,00**	ACH
Design Heating	**0,00**	ACH
Energy Analysis	**0,00**	ACH

Infiltration occurs at all hours.

6. Floors:

Type	**Slab Floor On Grade**	
Floor Area	**1600,0**	m²
Total Floor U-Value	**0,350**	W/(m²·K)
Exposed Perimeter	**80,0**	m
Edge Insulation R-Value	**1,00**	(m²·K)/W

7. Partitions:

7.1. 1st Partition Details:

Partition Type	**Wall Partition**	
Area	**276,0**	m²
U-Value	**2,561**	W/(m²·K)
Uncondit. Space Max Temp	**30,0**	°C
Ambient at Space Max Temp	**29,0**	°C
Uncondit. Space Min Temp	**10,0**	°C
Ambient at Space Min Temp	**27,0**	°C

7.2. 2nd Partition Details:

(No partition data).

Space Input Data

LV1 Electrical Pod

1. General Details:

Floor Area ..... **45,6** m²
Avg. Ceiling Height ..... **3,2** m
Building Weight ..... **146,5** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **0,0** L/s
OA Requirement 2 ..... **0,0** L/s
Space Usage Defaults ..... **ASHRAE Std 62.1-2013**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Free Hanging**
Wattage ..... **0,00** W/m²
Ballast Multiplier **1,00**
Schedule ..... **None**

2.2. Task Lighting:

Wattage ..... **0,00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **0,0** Watts
Schedule ..... **None**

2.4. People:

Occupancy ..... **0,0** Person
Activity Level ..... **Medium Work**
Sensible ..... **86,5** W/person
Latent ..... **133,3** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
S	12,2	0	0	0
E	19,2	0	0	0
W	38,4	0	0	0

3.1. Construction Types for Exposure S

Wall Type ..... **Container Wall**

3.2. Construction Types for Exposure E

Wall Type ..... **Container Wall**

3.3. Construction Types for Exposure W

Wall Type ..... **Container Wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	45,6	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Container Roof**

5. Infiltration:

Design Cooling ..... **0,30** ACH
Design Heating ..... **0,00** ACH
Energy Analysis ..... **0,00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Slab Floor On Grade**
Floor Area ..... **45,6** m²
Total Floor U-Value ..... **0,350** W/(m²·K)
Exposed Perimeter ..... **31,6** m
Edge Insulation R-Value ..... **1,00** (m²·K)/W

7. Partitions:

(No partition data).

LV2 Electrical Pod

1. General Details:

Floor Area ..... **42,1** m²
Avg. Ceiling Height ..... **3,2** m
Building Weight ..... **146,5** kg/m²

1.1. OA Ventilation Requirements:

Space Usage ..... **User-Defined**
OA Requirement 1 ..... **0,0** L/s
OA Requirement 2 ..... **0,0** L/s
Space Usage Defaults ..... **ASHRAE Std 62.1-2013**

2. Internals:

2.1. Overhead Lighting:

Fixture Type ..... **Free Hanging**
Wattage ..... **0,00** W/m²
Ballast Multiplier **1,00**
Schedule ..... **None**

2.2. Task Lighting:

Wattage ..... **0,00** W/m²
Schedule ..... **None**

2.3. Electrical Equipment:

Wattage ..... **0,0** Watts
Schedule ..... **None**

2.4. People:

Occupancy ..... **0,0** Person
Activity Level ..... **Medium Work**
Sensible ..... **86,5** W/person
Latent ..... **133,3** W/person
Schedule ..... **None**

2.5. Miscellaneous Loads:

Sensible ..... **0** W
Schedule ..... **None**
Latent ..... **0** W
Schedule ..... **None**

3. Walls, Windows, Doors:

Exp.	Wall Gross Area (m²)	Window 1 Qty.	Window 2 Qty.	Door 1 Qty.
N	12,2	0	0	0
E	35,5	0	0	0

3.1. Construction Types for Exposure N

Wall Type ..... **Container Wall**

3.2. Construction Types for Exposure E

Wall Type ..... **Container Wall**

4. Roofs, Skylights:

Exp.	Roof Gross Area (m²)	Roof Slope (deg.)	Skylight Qty.
H	42,1	0	0

4.1. Construction Types for Exposure H

Roof Type ..... **Container Roof**

5. Infiltration:

Design Cooling ..... **0,30** ACH
Design Heating ..... **0,00** ACH
Energy Analysis ..... **0,00** ACH
Infiltration occurs at all hours.

6. Floors:

Type ..... **Slab Floor On Grade**
Floor Area ..... **42,1** m²
Total Floor U-Value ..... **0,350** W/(m²·K)
Exposed Perimeter ..... **29,8** m
Edge Insulation R-Value ..... **1,00** (m²·K)/W

7. Partitions:

(No partition data).

Zone Design Load Summary for Critical chw cooling

Project Name: MIL07_WS3_CriticalSpaces 10/27/2025
Prepared by: DBA PRO. S.p.A. 10:11

Zone 1	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 2300 COOLING OA DB / WB 30,0 °C / 26,7 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -10,1 °C / -10,9 °C		
	OCCUPIED T-STAT 25,0 °C			OCCUPIED T-STAT 20,0 °C		
ZONE LOADS	Details	Sensible (W)	Latent (W)	Details	Sensible (W)	Latent (W)
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	1030 m²	2206	-	1030 m²	5650	-
Roof Transmission	3288 m²	6594	-	3288 m²	16741	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	3288 m²	0	-	3288 m²	5719	-
Partitions	552 m²	6674	-	552 m²	14137	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	140	507	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	-	15614	507	-	42246	0

TABLE 1.1.A. Component Loads For Space "LV1 Electrical Pod" In Zone "Zone 1"						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1600 COOLING OA DB / WB 37,7 °C / 28,4 °C OCCUPIED T-STAT 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -10,1 °C / -10,9 °C OCCUPIED T-STAT 20,0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	70 m²	414	-	70 m²	727	-
Roof Transmission	46 m²	324	-	46 m²	496	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	46 m²	0	-	46 m²	243	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	184	266	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**922**	**266**	**-**	**1466**	**0**

TABLE 1.1.B. Envelope Loads For Space "LV1 Electrical Pod" In Zone "Zone 1"						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
S EXPOSURE						
WALL	12	0,346	-	70	-	127
E EXPOSURE						
WALL	19	0,346	-	92	-	200
W EXPOSURE						
WALL	38	0,346	-	253	-	400
H EXPOSURE						
ROOF	46	0,361	-	324	-	496

TABLE 1.2.A. Component Loads For Space "LV2 Electrical Pod" In Zone "Zone 1"						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 1500 COOLING OA DB / WB 38,0 °C / 28,5 °C OCCUPIED T-STAT 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -10,1 °C / -10,9 °C OCCUPIED T-STAT 20,0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	48 m²	215	-	48 m²	497	-
Roof Transmission	42 m²	307	-	42 m²	458	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	42 m²	0	-	42 m²	225	-
Partitions	0 m²	0	-	0 m²	0	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	174	246	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**696**	**246**	**-**	**1180**	**0**

TABLE 1.2.B. Envelope Loads For Space "LV2 Electrical Pod" In Zone "Zone 1"						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
N EXPOSURE						
WALL	12	0,346	-	50	-	127
E EXPOSURE						
WALL	36	0,346	-	165	-	370
H EXPOSURE						
ROOF	42	0,361	-	307	-	458

TABLE 1.3.A. Component Loads For Space "DH01 Data Hall" In Zone "Zone 1"						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0000 COOLING OA DB / WB 29,4 °C / 26,5 °C OCCUPIED T-STAT 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -10,1 °C / -10,9 °C OCCUPIED T-STAT 20,0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	456 m²	910	-	456 m²	2213	-
Roof Transmission	1600 m²	3199	-	1600 m²	7894	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	1600 m²	0	-	1600 m²	2625	-
Partitions	276 m²	3361	-	276 m²	7068	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**7470**	**0**	**-**	**19800**	**0**

TABLE 1.3.B. Envelope Loads For Space "DH01 Data Hall" In Zone "Zone 1"						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
NW EXPOSURE						
WALL	456	0,161	-	910	-	2213
H EXPOSURE						
ROOF	1600	0,164	-	3199	-	7894

TABLE 1.4.A. Component Loads For Space "DH02 Data Hall" In Zone "Zone 1"						
	DESIGN COOLING			DESIGN HEATING		
	COOLING DATA AT Jul 0000 COOLING OA DB / WB 29,4 °C / 26,5 °C OCCUPIED T-STAT 25,0 °C			HEATING DATA AT DES HTG HEATING OA DB / WB -10,1 °C / -10,9 °C OCCUPIED T-STAT 20,0 °C		
		Sensible	Latent		Sensible	Latent
SPACE LOADS	**Details**	**(W)**	**(W)**	**Details**	**(W)**	**(W)**
Window & Skylight Solar Loads	0 m²	0	-	0 m²	-	-
Wall Transmission	456 m²	910	-	456 m²	2213	-
Roof Transmission	1600 m²	3199	-	1600 m²	7894	-
Window Transmission	0 m²	0	-	0 m²	0	-
Skylight Transmission	0 m²	0	-	0 m²	0	-
Door Loads	0 m²	0	-	0 m²	0	-
Floor Transmission	1600 m²	0	-	1600 m²	2625	-
Partitions	276 m²	3361	-	276 m²	7068	-
Ceiling	0 m²	0	-	0 m²	0	-
Overhead Lighting	0 W	0	-	0	0	-
Task Lighting	0 W	0	-	0	0	-
Electric Equipment	0 W	0	-	0	0	-
People	0	0	0	0	0	0
Infiltration	-	0	0	-	0	0
Miscellaneous	-	0	0	-	0	0
Safety Factor	0% / 0%	0	0	0%	0	0
>> Total Zone Loads	**-**	**7470**	**0**	**-**	**19800**	**0**

TABLE 1.4.B. Envelope Loads For Space "DH02 Data Hall" In Zone "Zone 1"						
				COOLING	COOLING	HEATING
	Area	U-Value	Shade	TRANS	SOLAR	TRANS
	(m²)	(W/(m²·K))	Coeff.	(W)	(W)	(W)
NW EXPOSURE						
WALL	456	0,161	-	910	-	2213
H EXPOSURE						
ROOF	1600	0,164	-	3199	-	7894

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:
STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-DC-XX-CA-M-54030

13038001

Title:
Calculation Fuel System Tanks Sizing

PD0 - RIBA 3	**ITM**	**54030**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

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P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Fuel System - Tanks Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-54030
Date	7-11-2025
Revision	P01

Fuel tank calculation for critical gensets

Description	[Value]	[UM]	Remarks
Fuel consumption calculation			
Fuel consumption - Genset 3,100 kW	762	[lpH]	Ref. CAT gen data
Total number of gensets	1	[-]	Each generator with its own tank
Maximum number of gensets in use simultaneously	1		
Total fuel consumption	**762**	**[lpH]**	
Underground tank volume calculation			
Required runtime	48	[h]	
Total required fuel storage volume	36576	[l]	
Day tank volume	0	[l]	Safety factor
Maximum filling percentage underground tank	85%	[%]	
Underground tank required fuel storage volume	43031	[l]	Minus day tank volume
Desing underground tank volume	**50000**	**[l]**	
Check	116,20%		

Fuel tank calculation for house gensets

Description	[Value]	[UM]	Remarks
Fuel consumption calculation			
Fuel consumption - Genset 1,000 kW	253	[lpH]	Ref. CAT gen data
Total number of gensets	1	[-]	Each generator with its own tank
Maximum number of gensets in use simultaneously	1		
Total fuel consumption	**253**	**[lpH]**	
Underground tank volume calculation			
Required runtime	48	[h]	
Total required fuel storage volume	12144	[l]	
Day tank volume	0	[l]	Safety factor
Maximum filling percentage underground tank	85%	[%]	
Underground tank required fuel storage volume	14287	[l]	Minus day tank volume
Desing underground tank volume	**15000**	**[l]**	
Check	104,99%		

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-55010

13038001

Title:

Calculation
Critical Cooling System
Equipments Sizing

PD0 - RIBA 3	**ITM**	**55010**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

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Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Critical Cooling System - Equipments Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-55010
Date	7-11-2025
Revision	P01

Phase 1 6 MW

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Number of DM	1	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Max chiller restart time	180	sec	From power on to 100% of cooling capacity
Max break time	20	sec	Generators starting time
Max failure time	200	sec	From power off to 100% cooling capacity
DH01 Fan Wall sizing			
DH01 IT load for air cooling	6000	kW	
DH01 envelope and internal loads	111	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Total DH01 net cooling capacity	6111	kW	
Number of Fan Walls per DH01	**14**	**[-]**	**N+2**
Number of redundant Fan Walls per DH01	2	[-]	+2
Number of Fan Walls per DH01 in N configuration	12	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per DH01 Fan Wall	535	kW	
Design DH01 Fan Wall net capacity	**540**	**kW**	
Capacity check	100,99%		
Electrical Pod Critical Powerblock (1A, 1B, 1C) LV1 CRAH sizing			
Electrical Pod CP LV1 net cooling load	96,9	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod CP LV1	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod CP LV1	1	[-]	+1
Number of CRAH per Electrical Pod CP LV1 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod CP LV1 CRAH	102	kW	
Design Electrical Pod CP LV1 CRAH net capacity	**105**	**kW**	
Capacity check	103,20%		
Electrical Pod Critical Powerblock (1A, 1B, 1C) LV2 CRAH sizing			
Electrical Pod CP LV2 net cooling load	44	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod CP LV2	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod CP LV2	1	[-]	+1
Number of CRAH per Electrical Pod CP LV2 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod CP LV2 CRAH	46	kW	
Design Electrical Pod CP LV2 CRAH net capacity	**50**	**kW**	
Capacity check	108,23%		
Electrical Pod R1 LV1 CRAH sizing			
Electrical Pod R1 LV1 net cooling load	96,9	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod R1 LV1	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod R1 LV1	1	[-]	+1
Number of CRAH per Electrical Pod R1 LV1 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod R1 LV1 CRAH	102	kW	
Design Electrical Pod R1 LV1 CRAH net capacity	**105**	**kW**	
Capacity check	103,20%		
Electrical Pod R1 LV2 CRAH sizing			
Electrical Pod R1 LV2 net cooling load	16,1	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod R1 LV2	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod R1 LV2	1	[-]	+1
Number of CRAH per Electrical Pod R1 LV2 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod R1 LV2 CRAH	17	kW	
Design Electrical Pod R1 LV2 CRAH net capacity	**25**	**kW**	
Capacity check	147,89%		
Electrical Pod H1 LV1 CRAH sizing			
Electrical Pod H1 LV1 net cooling load	16,7	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod H1 LV1	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod H1 LV1	1	[-]	+1
Number of CRAH per Electrical Pod H1 LV1 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod H1 LV1 CRAH	18	kW	
Design Electrical Pod H1 LV1 CRAH net capacity	**25**	**kW**	
Capacity check	142,57%		

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Critical Cooling System - Equipments Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-55010
Date	7-11-2025
Revision	P01

Phase 1 6 MW

Description	[Value]	[UM]	Remarks
Chillers sizing			
DH net cooling load	6111	kW	
DH Fan Wall fans losses	336	kW	5% of Fan Wall cooling capacity: 24 kW x Fan Wall units (N+2 units working)
Electrical pods gross cooling load (fans losses included)	411,5	kW	2 x critical powerlock pods with CRAH cooling (failure mode, one powerblock down) + R1 pod + H1 pod
CERs gross cooling load (fans losses included)	80	kW	2 x CER with CRAH cooling (40 kW each)
Total required cooling capacity	6939	kW	
Number of chillers	**8**	**[-]**	**N+2**
Number of redundant chillers	2	[-]	+2
Number of chillers in N configuration	6	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per chiller	1214	kW	
Design chiller net capacity	**1220**	**kW**	
Capacity check	100,47%		
TES tanks sizing			
Total required cooling capacity	6939	kW	
Design delta T	10	°C	
Total required critical chw water flow	166	l/sec	
Fault time considered for TES sizing	**300**	**sec**	**5 minutes**
Total net TES water volume required	**50**	**mc**	
Tank net/gross ratio	0,8	[-]	Squared tank considered
TES gross volume	62,2	mc	
Number of groups of tanks	2	[-]	1 group of tanks for each critical chw riser (N+1)
Groups redundancy	1	[-]	+1
Number of groups in N configuration	1	[-]	N
TES gross volume for group	62,2	mc	Volume to guarantee N+1
Number of tanks for each group	2	[-]	N (no redundancy in the group)
Number of redundant tanks in a group	0	[-]	
Number of tanks in a group in N configuration	2	[-]	N
TES gross volume per tank	31,1	mc	
Design tank capacity	**35**	**mc**	
Capacity check	112,62%		
Total of tanks installed	**4**	**[-]**	
Total gross TES volume installed	140	mc	
Critical chw water flow considering N+2 chillers at max capacity	233	l/sec	Considering constant summer design ambient T
Time required to refill the tanks after a failure	35	min	
Critical chw water flow considering N chillers at max capacity	175	l/sec	Considering constant summer design ambient T
Time required to refill the tanks after a failure	256	min	

Client:	STACK INFRASTRUCTURE
Project	MIL07
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Phase 2 12 MW

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Number of DM	2	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Max chiller restart time	180	sec	From power on to 100% of cooling capacity
Max break time	20	sec	Generators starting time
Max failure time	200	sec	From power off to 100% cooling capacity
DH02 Fan Wall sizing			
DH02 IT load for air cooling	6000	kW	
DH02 envelope and internal loads	111	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Total DH01 net cooling capacity	6111	kW	
Number of Fan Walls per DH02	**14**	**[-]**	**N+2**
Number of redundant Fan Walls per DH02	2	[-]	+2
Number of Fan Walls per DH02 in N configuration	12	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per DH02 Fan Wall	535	kW	
Design DH02 Fan Wall net capacity	**540**	**kW**	
Capacity check	100,99%		
Electrical Pod Critical Powerblock (2A, 2B, 2C) LV1 CRAH sizing			
Electrical Pod CP LV1 net cooling load	96,9	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod CP LV1	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod CP LV1	1	[-]	+1
Number of CRAH per Electrical Pod CP LV1 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod CP LV1 CRAH	102	kW	
Design Electrical Pod CP LV1 CRAH net capacity	**105**	**kW**	
Capacity check	103,20%		
Electrical Pod Critical Powerblock (2A, 2B, 2C) LV2 CRAH sizing			
Electrical Pod CP LV2 net cooling load	44	kW	See MIL07-DBA-ZZ-XX-CA-M-50002
Number of CRAH per Electrical Pod CP LV2	**2**	**[-]**	**N+1**
Number of redundant CRAH per Electrical Pod CP LV2	1	[-]	+1
Number of CRAH per Electrical Pod CP LV2 in N configuration	1	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per Electrical Pod CP LV2 CRAH	46	kW	
Design Electrical Pod CP LV2 CRAH net capacity	**50**	**kW**	
Capacity check	108,23%		
Chillers sizing			
DH net cooling load	12222	kW	
DH Fan Wall fans losses	672	kW	5% of Fan Wall cooling capacity: 24 kW x Fan Wall units (N+2 units working)
Electrical pods gross cooling load (fans losses included)	834,2	kW	5 x critical powerlock pods with CRAH cooling (failure mode, one powerblock down) + R1 pod + H1 pod
CERs gross cooling load (fans losses included)	80	kW	2 x CER with CRAH cooling (40 kW each)
Total required cooling capacity	13808	kW	
Number of chillers	**14**	**[-]**	**N+2**
Number of redundant chillers	2	[-]	+2
Number of chillers in N configuration	12	[-]	N
Design safety factor	5,00%		
Min net cooling capacity per chiller	1208	kW	
Design chiller net capacity	**1220**	**kW**	
Capacity check	100,98%		
TES tanks sizing			
Total required cooling capacity	13808	kW	
Design delta T	10	°C	
Total required critical chw water flow	330	l/sec	
Fault time considered for TES sizing	**300**	**sec**	**5 minutes**
Total net TES water volume required	**99**	**mc**	
Tank net/gross ratio	0,8	[-]	Squared tank considered
TES gross volume	123,7	mc	
Number of groups of tanks	3	[-]	1 group of tanks for each critical chw riser (N+1)
Groups redundancy	1	[-]	+1
Number of groups in N configuration	2	[-]	N
TES gross volume for group	61,8	mc	Volume to guarantee N+1
Number of tanks for each group	2	[-]	N (no redundancy in the group)
Number of redundant tanks in a group	0	[-]	
Number of tanks in a group in N configuration	2	[-]	N
TES gross volume per tank	30,9	mc	
Design tank capacity	**35**	**mc**	
Capacity check	113,18%		
Total of tanks installed	**6**	**[-]**	
Total gross TES volume installed	210	mc	
Critical chw water flow considering N+2 chillers at max capacity	408	l/sec	Considering constant summer design ambient T
Time required to refill the tanks after a failure	45	min	
Critical chw water flow considering N chillers at max capacity	350	l/sec	Considering constant summer design ambient T
Time required to refill the tanks after a failure	176	min	

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Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-55011

13038001

Title:

Calculation
Critical Cooling System
Expansion Vessel Sizing

PD0 - RIBA 3	**ITM**	**55011**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

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Project	MIL07
Document:	Calculation - Critical Cooling System - Expansion Vessel Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-55011
Date	7-11-2025
Revision	P01

Phase 1 6 MW

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Summer ambient design temperature	38	°C	ASHRAE 2025 extreme climate condition n=20
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Max safety pressure	5	bar	
Hydrostatic head	10	m	
Vessel Sizing			
Chw fluid max temperature	40	°C	
Chw fluid density at max temperature	992,25	kg/mc	
Chw fluid min temperature	5	°C	System protected with trace heating system
Chw fluid density at min temperature	1000	kg/mc	
Chw system volume	200	mc	Value extimated, to be detailed in next stage
Expansion coefficient	0,007750	[-]	
Expansion volume	1,55	mc	
Water reserve	1,00	mc	0,5% of system volume
Safety factor	10,00%		
Expansion system min volume	2,81	mc	
Number of expansion system	**2**	**[-]**	**N+1**
Number of redundant expansion system	1	[-]	+1
Number of expansion system in N configuration	1	[-]	N
Min net volume per expansion system	2,81	mc	
Design expansion system volume	**3**	**mc**	**1 vessels for each expansion system**
Capacity check	106,95%		

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Critical Cooling System - Expansion Vessel Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-55011
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Revision	P01

Phase 2 12 MW

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Summer ambient design temperature	38	°C	ASHRAE 2025 extreme climate condition n=20
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Max safety pressure	5	bar	
Hydrostatic head	10	m	
Vessel Sizing			
Chw fluid max temperature	40	°C	
Chw fluid density at max temperature	992,25	kg/mc	
Chw fluid min temperature	5	°C	System protected with trace heating system
Chw fluid density at min temperature	1000	kg/mc	
Chw system volume	310	mc	Value extimated, to be detailed in next stage
Expansion coefficient	0,007750	[-]	
Expansion volume	2,40	mc	
Water reserve	1,55	mc	0,5% of system volume
Safety factor	10,00%		
Expansion system min volume	4,35	mc	
Number of expansion system	**3**	**[-]**	**N+1**
Number of redundant expansion system	1	[-]	+1
Number of expansion system in N configuration	2	[-]	N
Min net volume per expansion system	2,17	mc	
Design expansion system volume	**3**	**mc**	**1 vessels for each expansion system**
Capacity check	138,00%		

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-55012

13038001

Title:

Calculation
Critical Cooling System
Pump Pressure Drop

PD0 - RIBA 3	**ITM**	**55012**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
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Project	MIL07
Document:	Calculation - Critical Cooling System - Pump Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-55012
Date	7-11-2025
Revision	P01

Fluid properties		spec. Mass	Spec. Heat	Kinematic Viscosity
		[kg/m3]	[kJ/kgK]	[m2/s]
Water / glycol	100%	997	4,18	0,00000089

Calculation to be finalized after equipments

Input For Normal Operation				
Unit	Cooling capacity		water flow	
Fan Wall	462,9	kW	11,1	[l/s]
Chiller	1046,0	kW	25,0	[l/s]
CRAH LV ROOM 1	105,0	kW	2,5	[l/s]
CRAH LV ROOM 2	50,0	kW	1,2	[l/s]
CRAH CER	40,0	kW	1,0	[l/s]
Delta T	10,00	K		

Section		Part	Capacity			Pipes			System Parts				Calculation Results				Remarks
Section description		Part	Pipeline flow	Flow added	Pipeline flow	d nominal	di	l	Type	number	Kvs	zeta	v	R	Z	dP	Remarks
			[m3/h]	[l/s]	[l/s]		[mm]	[m]	[-]	[-]	[-]	[-]	[m/s]	[Pa/m]	[Pa]	[Pa]	
										Flow + Return							
		DH01															
Fan Wall DH01-FWU-01	A	Fan Wall DH01-FWU-01	40	11,06	11,06					1					99,000	99,000	
Pipe Accessories	A	Antivibration joint	40		11,06	100,0	107,1		Valve	2	1,508	0,16	1,23		70	139	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,1		2			1,23	121		22	
Pipe Fittings	A	Piping/Fitting	40		11,06	100,0	107,1		90.0 Degree	2		0,31	1,23		233	466	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,6		2			1,23	121		154	
Pipe Accessories	A	Butterfly Valve	40		11,06	100,0	107,1		Valve	2	640	0,16	1,23		387	774	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,1		2			1,23	121		30	
Pipe Accessories	A	Y Filter	40		11,06	100,0	107,1		Valve	1	201	0,16	1,23		3.922	3.922	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,1		2			1,23	121		30	
Pipe Accessories	A	Butterfly Valve	40		11,06	100,0	107,1		Valve	2	640	0,16	1,23		387	774	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,2		2			1,23	121		46	
Tee	A	Tee	40		11,06	100,0	107,1		90.0 Degree	2		0,31	1,23		233	466	
Pipes	A	Piping/Fitting	40		11,06	100,0	107,1	0,2		2			1,23	121		59	
Tee	A	Tee	40		11,06	250,0	260,4		90.0 Degree	2		0,25	0,21		5	11	
Pipes	A	Piping/Fitting	40		11,06	250,0	260,4	2,8		2			0,21	2		10	
Pipe Accessories	A	Butterfly Valve	40		11,06	250,0	260,4		Valve	2	5.762	0,06	0,21		5	10	
Pipes	A	Piping/Fitting	40		11,06	250,0	260,4	1,5		2			0,21	2		5	
Connection with Fan Wall DH01-FWU-02	B	Tee	80	11,06	22,11	250,0	260,4		In-line	2		0,09	0,42		8	15	
Pipes	B	Piping/Fitting	80		22,11	250,0	260,4	3,7		2			0,42	6		44	
Pipe Accessories	B	Butterfly Valve	80		22,11	250,0	260,4		Valve	2	5.762	0,06	0,42		19	38	
Pipes	B	Piping/Fitting	80		22,11	250,0	260,4	2,4		2			0,42	6		28	
Connection with Fan Wall DH01-FWU-03	C	Tee	119	11,06	33,17	250,0	260,4		In-line	2		0,09	0,62		17	35	
Pipes	C	Piping/Fitting	119		33,17	250,0	260,4	2,8		2			0,62	12		67	
Pipe Accessories	C	Butterfly Valve	119		33,17	250,0	260,4		Valve	2	5.762	0,06	0,62		43	86	
Pipes	C	Piping/Fitting	119		33,17	250,0	260,4	1,5		2			0,62	12		37	
Connection with Fan Wall DH01-FWU-04	D	Tee	159	11,06	44,23	250,0	260,4		In-line	2		0,09	0,83		31	62	
Pipes	D	Piping/Fitting	159		44,23	250,0	260,4	3,7		2			0,83	21		151	
Pipe Accessories	D	Butterfly Valve	159		44,23	250,0	260,4		Valve	2	5.762	0,06	0,83		76	153	
Pipes	D	Piping/Fitting	159		44,23	250,0	260,4	2,4		2			0,83	21		99	
Connection with Fan Wall DH01-FWU-05	E	Tee	199	11,06	55,29	250,0	260,4		In-line	2		0,09	1,04		48	97	
Pipes	E	Piping/Fitting	199		55,29	250,0	260,4	2,9		2			1,04	31		177	
Pipe Accessories	E	Butterfly Valve	199		55,29	250,0	260,4		Valve	2	5.762	0,06	1,04		119	239	
Pipes	E	Piping/Fitting	199		55,29	250,0	260,4	1,4		2			1,04	31		88	
Connection with Fan Wall DH01-FWU-06	F	Tee	239	11,06	66,34	250,0	260,4		In-line	2		0,09	1,25		70	139	
Pipes	F	Piping/Fitting	239		66,34	250,0	260,4	3,7		2			1,25	43		315	
Pipe Accessories	F	Butterfly Valve	239		66,34	250,0	260,4		Valve	2	5.762	0,06	1,25		172	344	
Pipes	F	Piping/Fitting	239		66,34	250,0	260,4	2,4		2			1,25	43		210	
Connection with Fan Wall DH01-FWU-07	G	Tee	279	11,06	77,40	250,0	260,4		In-line	2		0,09	1,45		95	190	
Pipes	G	Piping/Fitting	279		77,40	250,0	260,4	2,8		2			1,45	57		326	
Pipe Accessories	G	Butterfly Valve	279		77,40	250,0	260,4		Valve	2	5.762	0,06	1,45		234	468	
Pipes	G	Piping/Fitting	279		77,40	250,0	260,4	1,4		2			1,45	57		165	
Connection with Fan Wall DH01-FWU-08	H	Tee	318	11,06	88,46	250,0	260,4		In-line	2		0,09	1,66		124	248	
Pipes	H	Piping/Fitting	318		88,46	250,0	260,4	3,6		2			1,66	73		532	
Pipe Accessories	H	Butterfly Valve	318		88,46	250,0	260,4		Valve	2	5.762	0,06	1,66		305	611	
Pipes	H	Piping/Fitting	318		88,46	250,0	260,4	2,5		2			1,66	73		359	
Connection with Fan Wall DH01-FWU-09	I	Tee	358	11,06	99,51	250,0	260,4		In-line	2		0,09	1,87		157	313	
Pipes	I	Piping/Fitting	358		99,51	250,0	260,4	2,8		2			1,87	91		515	
Pipe Accessories	I	Butterfly Valve	358		99,51	250,0	260,4		Valve	2	5.762	0,06	1,87		387	773	
Pipes	I	Piping/Fitting	358		99,51	250,0	260,4	1,5		2			1,87	91		265	
Connection with Fan Wall DH01-FWU-10	J	Tee	398	11,06	110,57	250,0	260,4		In-line	2		0,09	2,08		193	387	
Pipes	J	Piping/Fitting	398		110,57	250,0	260,4	3,7		2			2,08	110		815	
Pipe Accessories	J	Butterfly Valve	398		110,57	250,0	260,4		Valve	2	5.762	0,06	2,08		477	955	
Pipes	J	Piping/Fitting	398		110,57	250,0	260,4	2,4		2			2,08	110		531	
Connection with Fan Wall DH01-FWU-11	K	Tee	438	11,06	121,63	250,0	260,4		In-line	2		0,09	2,28		234	468	
Pipes	K	Piping/Fitting	438		121,63	250,0	260,4	2,8		2			2,28	132		729	
Pipe Accessories	K	Butterfly Valve	438		121,63	250,0	260,4		Valve	2	5.762	0,06	2,28		577	1.155	
Pipes	K	Piping/Fitting	438		121,63	250,0	260,4	1,5		2			2,28	132		403	
Connection with Fan Wall DH01-FWU-12	L	Tee	478	11,06	132,69	250,0	260,4		In-line	2		0,09	2,49		278	557	
Pipes	L	Piping/Fitting	478		132,69	250,0	260,4	3,7		2			2,49	155		1.159	
Pipe Accessories	L	Butterfly Valve	478		132,69	250,0	260,4		Valve	2	5.762	0,06	2,49		687	1.374	
Pipes	L	Piping/Fitting	478		132,69	250,0	260,4	2,4		2			2,49	155		729	
Connection with Fan Wall DH01-FWU-13	M	Tee	517	11,06	143,74	250,0	260,4		In-line	2		0,09	2,70		327	654	
Pipes	M	Piping/Fitting	517		143,74	250,0	260,4	2,9		2			2,70	180		1.040	
Pipe Accessories	M	Butterfly Valve	517		143,74	250,0	260,4		Valve	2	5.762	0,06	2,70		807	1.613	
Pipes	M	Piping/Fitting	517		143,74	250,0	260,4	1,4		2			2,70	180		503	
Connection with Fan Wall DH01-FWU-14	N	Tee	557	11,06	154,80	250,0	260,4		In-line	2		0,09	2,91		379	758	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	3,2		2			2,91	207		1.301	
Pipe Accessories	N	Butterfly Valve	557		154,80	250,0	260,4		Valve	2	5.762	0,06	2,91		935	1.871	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	2,1		2			2,91	207		881	
Tee	N	Tee	557		154,80	250,0	260,4		In-line	2		0,09	2,91		379	758	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	3,1		1			2,91	207		636	
250,1	N	Piping/Fitting	557		154,80	250,0	260,4	0,7		1			2,91	207		153	
Pipe Fittings	N	Piping/Fitting	557		154,80	250,0	260,4		90.0 Degree	1		0,25	2,91		1.053	1.053	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	0,2		1			2,91	207		43	
Pipe Fittings	N	Piping/Fitting	557		154,80	250,0	260,4		90.0 Degree	1		0,25	2,91		1.053	1.053	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	1,0		1			2,91	207		213	
Pipe Accessories	N	Butterfly Valve	557		154,80	250,0	260,4		Valve	2	5.762	0,06	2,91		935	1.871	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	1,0		2			2,91	207		393	
Tee	N	Tee	557		154,80	250,0	260,4		90.0 Degree	2		0,25	2,91		1.053	2.106	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	0,1		2			2,91	207		21	
Pipe Fittings	N	Piping/Fitting	557		154,80	250,0	260,4		45.0 Degree	2		0,16	2,91		674	1.348	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	7,7		2			2,91	207		3.192	
Pipe Fittings	N	Piping/Fitting	557		154,80	250,0	260,4		90.0 Degree	2		0,25	2,91		1.053	2.106	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	2,1		2			2,91	207		875	
Pipe Accessories	N	Butterfly Valve	557		154,80	250,0	260,4		Valve	2	5.762	0,06	2,91		935	1.871	
Pipes	N	Piping/Fitting	557		154,80	250,0	260,4	1,7		2			2,91	207		688	
Connection to the riser	O	Tee	627	19,23	174,03	250,0	260,4		90.0 Degree	2		0,25	3,27		1.331	2.662	**Water flow coming from CRAHs installed inside phs. 1 PODs, CER01 and CER02**
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		2			3,27	257		77	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	2	5.762	0,06	3,27		1.182	2.365	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,0		2			3,27	257		491	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	2		0,25	3,27		1.331	2.662	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,0		2			3,27	257		503	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	2	5.762	0,06	3,27		1.182	2.365	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	3,0		1			3,27	257		761	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Tee	O	Tee	627		174,03	250,0	260,4		In-line	1		0,09	3,27		479	479	
Pipes	O	Piping/Fitting	627		174,03	251,0	260,4	0,9		1			3,27	257		229	
Pipe Accessories	O	Butterfly Valve	627		174,03	252,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	253,0	260,4	0,5		1			3,27	257		126	
Pipe Fittings	O	Piping/Fitting	627		174,03	254,0	260,4		90.0 Degree	2		0,25	3,27		1.331	2.662	
Pipes	O	Piping/Fitting	627		174,03	255,0	260,4	3,6		1			3,27	257		925	
Pipe Fittings	O	Piping/Fitting	627		174,03	256,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	257,0	260,4	1,0		1			3,27	257		267	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,4		1			3,27	257		370	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	3,6		1			3,27	257		938	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	61,5		1			3,27	257		15.796	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,8		1			3,27	257		209	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,7		1			3,27	257		188	
By pass	O	Tee	627		174,03	250,0	260,4		In-line	1		0,09	3,27		479	479	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,0		1			3,27	257		250	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		49	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,3		1			3,27	257		82	
Pipe Accessories	O	Motorized valve	627		174,03	250,0	260,4	0,1	Valve	1	5.762	0,06	3,27	257	1.182	1.200	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,4		1			3,27	257		97	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		53	
Tee	O	Tee	627		174,03	250,0	260,4		In-line	1		0,09	3,27		479	479	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,4		1			3,27	257		115	
Tee	O	Tee	627		174,03	250,0	260,4		In-line	1		0,09	3,27		479	479	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,3		1			3,27	257		75	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,4		1			3,27	257		360	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		50	
Pipe Accessories	O	Antivibration joint	627		174,03	250,0	260,4		Valve	1	5.957	0,06	3,27		1.106	1.106	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,1		1			3,27	257		23	
Mechanical Equipment	O	Tank	627		174,03	250,0	260,4		90.0 Degree	2		0,25	3,27		1.331	2.662	**Water flow pressure drop inside the water tank considered equal to the water flow pressure drop of two 90° elbow fittings.**
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,1		1			3,27	257		23	
Pipe Accessories	O	Antivibration joint	627		174,03	250,0	260,4		Valve	1	5.957	0,06	3,27		1.106	1.106	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		59	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,4		1			3,27	257		351	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	2,2		1			3,27	257		557	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,3		1			3,27	257		341	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		50	
Pipe Accessories	O	Antivibration joint	627		174,03	250,0	260,4		Valve	1	5.957	0,06	3,27		1.106	1.106	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,1		1			3,27	257		23	
Mechanical Equipment	O	Tank	627		174,03	250,0	260,4		90.0 Degree	2		0,25	3,27		1.331	2.662	**Water flow pressure drop inside the water tank considered equal to the water flow pressure drop of two 90° elbow fittings.**
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,1		1			3,27	257		23	
Pipe Accessories	O	Antivibration joint	627		174,03	250,0	260,4		Valve	1	5.957	0,06	3,27		1.106	1.106	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,2		1			3,27	257		59	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,3		1			3,27	257		341	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,3		1			3,27	257		77	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,3		1			3,27	257		79	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,5		1			3,27	257		117	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,3		1			3,27	257		82	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,8		1			3,27	257		209	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	48,7		1			3,27	257		12.523	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	3,0		1			3,27	257		766	

Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,4		1			3,27	257		370	
Tee	O	Tee	627		174,03	250,0	260,4		90.0 Degree	1		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,348427		1			3,27	257		90	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,236748		1			3,27	257		61	
Pipe Accessories	O	Flow Meter	627		174,03	250,0	260,4		Other	1		Fill in	3,27			10	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	0,186133		1			3,27	257		48	
Pipe Accessories	O	Butterfly Valve	627		174,03	250,0	260,4		Valve	1	5.762	0,06	3,27		1.182	1.182	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,534958		1,00			3,27	257		395	
Pipe Fittings	O	Piping/Fitting	627		174,03	250,0	260,4		90.0 Degree	1,00		0,25	3,27		1.331	1.331	
Pipes	O	Piping/Fitting	627		174,03	250,0	260,4	1,038		1,00			3,27	257		267	
Connection to the ring	O	Tee	360	-74,08	99,95	250,0	260,4		90.0 Degree	2,00		0,25	1,88		439	878	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	1,554269		2,00			1,88	92		285	
Pipe Accessories	O	Butterfly Valve	360		99,95	250,0	260,4		Valve	2,00	5.762	0,06	1,88		390	780	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	2,891885		2,00			1,88	92		530	
Tee	O	Tee	360		99,95	250,0	260,4		90.0 Degree	2,00		0,25	1,88		439	878	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,19187		1,00			1,88	92		18	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,60645		1,00			1,88	92		56	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,250055		1,00			1,88	92		23	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	6,521548		2,00			1,88	92		1.195	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	2,00		0,16	1,88		281	562	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,320765		2,00			1,88	92		59	
Pipe Accessories	O	Butterfly Valve	360		99,95	250,0	260,4		Valve	2,00	5.762,00	0,06	1,88		390	780	
Pipe Accessories	O	Butterfly Valve	360		99,95	250,0	260,4		Valve	2,00	5.762,00	0,06	1,88		390	780	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	2,00		0,16	1,88		281	562	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,65111		2,00			1,88	92		119	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	2,00		0,16	1,88		281	562	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,320765		2,00			1,88	92		59	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	2,00		0,16	1,88		281	562	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	6,652801		2,00			1,88	92		1.219	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,250055		1,00			1,88	92		23	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,512028		1,00			1,88	92		47	
Pipe Fittings	O	Piping/Fitting	360		99,95	250,0	260,4		45.0 Degree	1,00		0,16	1,88		281	281	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	0,19187		1,00			1,88	92		18	
Tee	O	Tee	360		99,95	250,0	260,4		90.0 Degree	2,00		0,25	1,88		439	878	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	2,081626		2,00			1,88	92		382	
Pipe Accessories	O	Butterfly Valve	360		99,95	250,0	260,4		Valve	2,00	5.762	0,06	1,88		390	780	
Pipes	O	Piping/Fitting	360		99,95	250,0	260,4	3,197647		2,00			1,88	92		586	
Connection to CH-8	O	Tee	270	-24,99	74,96	250,0	260,4		In-line	2,00		0,09	1,41		89	178	
Pipes	O	Piping/Fitting	270		74,96	250,0	260,4	5,2		2,00			1,41	54		561	
Pipe Accessories	O	Butterfly Valve	270		74,96	250,0	260,4		Valve	2,00	5.762	0,06	1,41		219	439	
Pipes	O	Piping/Fitting	270		74,96	250,0	260,4	7,278		2,00			1,41	54		785	
Connection to CH-6	O	Tee	180	-24,99	49,98	250,0	260,4		In-line	2,00		0,09	0,94		40	79	
Pipes	O	Piping/Fitting	180		49,98	250,0	260,4	6,3		2,00			0,94	26		324	
Pipe Accessories	O	Butterfly Valve	180		49,98	250,0	260,4		Valve	2,00	5.762	0,06	0,94		97	195	
Pipes	O	Piping/Fitting	180		49,98	250,0	260,4	6,2		2,00			0,94	26		318	
Connection to CH-4	O	Tee	90	-24,99	24,99	250,0	260,4		In-line	2,00		0,09	0,47		10	20	
Pipes	O	Piping/Fitting	90		24,99	250,0	260,4	6,3		2,00			0,47	7		92	
Pipe Accessories	O	Butterfly Valve	90		24,99	250,0	260,4		Valve	2,00	5.762	0,06	0,47		24	49	
Pipes	O	Piping/Fitting	90		24,99	250,0	260,4	6,2		2,00			0,47	7		91	
Connection to CH-2	O	Tee	90		24,99	150	159,3		90.0 Degree	2,00		0,29	1,25		227	454	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,047		2,00			1,25	78		7	
Pipe Fittings	O	Piping/Fitting	90		24,99	150	159,3		90.0 Degree	2,00		0,29	1,25		227	454	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,93		2,00			1,25	78		146	
Tee	O	Tee	90		24,99	150	159,3		90.0 Degree	2,00		0,29	1,25		227	454	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,146435		2,00			1,25	78		23	
Pipe Accessories	O	Butterfly Valve	90		24,99	150	159,3		Valve	3,00	1.644	0,10	1,25		299	898	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	1,048172		2,00			1,25	78		164	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,10766		2,00			1,25	78		17	
Pipe Accessories	O	Non Return Valve	90		24,99	150	159,3		Valve	1,00	1.697,00	0,10	1,25		281	281	
Pipe Accessories	O	Y Strainer	90		24,99	150	159,3		Valve	1,00	1.260,00	0,10	1,25		510	510	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,072234		2,00			1,25	78		11	
Pipe Fittings	O	Piping/Fitting	90		24,99	150	159,3		90.0 Degree	2,00		0,29	1,25		227	454	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	1,228		2,00			1,25	78		192	
Tee	O	Tee	90		24,99	150	159,3		90.0 Degree	2,00		0,29	1,25		227	454	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,303293		2,00			1,25	78		48	
Pipe Accessories	O	Measuring Equipment	90		24,99	150	159,3		In-line	2,00		0,12	1,25		94	188	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,149		2,00			1,25	78		23	
Pipe Accessories	O	Measuring Equipment	90		24,99	150	159,3		In-line	2,00		0,12	1,25		94	188	
Pipes	O	Piping/Fitting	90		24,99	150	159,3	0,120652		2,00			1,25	78		19	
Pipe Accessories	O	Antivibration joint	90		24,99	150	159,3		Valve	2,00	4.261,00	0,10	1,25		45	89	**Connection to the chiller**

Piping supply/return		**274.000**	**Pa**
Spare	**20%**	**55.000**	**Pa**
Total		**330.000**	**Pa (rounded up to nearest 5 kPa)**

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-57020

13038001

Title:

Calculation
Critical Ventilation System
Data Hall Humidity

PD0 - RIBA 3	**ITM**	**57020**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Critical Ventilation System - Data Hall Humidity
Document ID	MIL07-DBA-ZZ-XX-CA-M-57020
Date	7-11-2025
Revision	P01

Data Hall

Description	[Value]	[UM]	Remarks
Location parameters			
Elevation	134	[m]	
Roof height	7	[m]	
Winter - Absolute humidity (99.6%)	1,4	[g/kg]	From Weather data (99.6% yearly max)
Winter - N=20 dry bulb temperature	-10,10	[°C]	From Weather data (N=20)
Winter - N=20 wet bulb temperature	-10,90	[°C]	From Weather data (N=20)
Winter - Absolute humidity (N=20)	1,2	[g/kg]	
Summer - Absolute humidity (0,4%)	18,2	[g/kg]	From Weather data (0.4% yearly max)
Summer - N=20 dry bulb temperature	38,00	[°C]	From Weather data (N=20)
Summer - N=20 wet bulb temperature	28,50	[°C]	From Weather data (N=20)
Summer - Absolute humidity (N=20)	21,0	[g/kg]	
DH design parameters			
Maximum temperature - Data Halls - Supply air to servers	29,4	[°C]	Stack STEER design
Dew Point - Maximum Data Halls	14,8	[°C]	Stack STEER design
Absolute humidity - Maximum Data Halls	**10,5**	**[g/kg]**	
Minimum temperature - Data Halls - Supply air to servers	20,6	[°C]	ASHRAE A1 temperature at 80%
Dew Point - Minimum Data Halls	5,5	[°C]	ASHRAE raccomanded range
Absolute humidity - Minimum Data Halls	**5,5**	**[g/kg]**	
Humidification			
Design airflow Data Hall	1400	[mc/h]	1 DOAS operating
Design air mass flow Data Hall	0,47	[kg/s]	
Infiltration area of façade	470	[mq]	
Mean coincident wind speed (Winter)	0,7	[m/s]	From ASHRAE Linate weather data
Infiltration amount through facade - estimate	0,0	[m/h/mq]	For mq of facade
Infiltration air volume	0	[mc/h]	
Mass flow air (infiltration)	0	[kg/s]	
Mass flow humidity (infiltration)	0	[g/s]	
Safety margin	1	[g/kg]	
Minimum humidity ratio supply	**6,5**	**[g/kg]**	
Dehumidification			
Design airflow Data Hall	1400	[mc/h]	1 DOAS operating
Design air mass flow Data Hall	0,47	[kg/s]	
Infiltration area of façade	470	[mq]	
Mean coincident wind speed (Summer)	2,1	[m/s]	From ASHRAE Linate weather data
Infiltration amount through facade - estimate	0,0	[m/h/mq]	For mq of facade
Infiltration air volume	0	[mc/h]	
Mass flow air (infiltration)	0	[kg/s]	
Mass flow humidity (infiltration)	0	[g/s]	
Safety margin	1	[g/kg]	
Maximum humidity ratio supply	**9,5**	**[g/kg]**	

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-57021

13038001

Title:

Calculation
Critical Ventilation System
Data Hall Overpressure

PD0 - RIBA 3	**ITM**	**57021**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Critical Ventilation System - Data Hall Ovrepressure
Document ID	MIL07-DBA-ZZ-XX-CA-M-57021
Date	7-11-2025
Revision	P01

Data Hall

Description	[Value]	[UM]	Remarks
Leakage parameters			
Air leakage wall (@ 10 Pa)	0,20	[l/s/mq]	
Air leakage doors (@ 25 Pa)	0,83	[l/s/m]	
Room parameters			
Length	79,7	[m]	
Width	24,7	[m]	
Height	6,0	[m]	Average height
Total walls area	1253	[mq]	
Doors parameters			
No. double doors	2	[-]	
No. single doors	3	[-]	
Door height	2,9	[m]	
Door width	1,0	[m]	
Double door circumference	9,8	[m]	
Single door circumference	7,8	[m]	
Total doors' circumference	43,0	[m]	
Leakage calculations			
Wall leakage (@ 10 Pa)	251	[l/s]	
	902	[mc/h]	
Door leakage (@ 25 Pa)	36	[l/s]	
	128	[mc/h]	
Door leakage (@ 10 Pa)	81	[mc/h]	
Design margin	10%	[%]	
Total leakage	**1082**	**[mc/h]**	
Design DOAS air supply	1400	[mc/h]	1 DOAS operating
Check	129,44%		

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-57022

13038001

Title:

Calculation
Ventilation Systems
AHUs Pressure Drop

PD0 - RIBA 3	**ITM**	**57022**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	MC	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	3140	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

A1-AHU-1 Air Supply

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	name	Shape	Circular	Rectangular		Hydraulic	Length	Flowrate added	Flowrate	Number	Bend/branch	Type	ζ		Other items			Total	c/s/ area	Velocity	Frictional loss	Branch/bend loss	Equipment Losses	Total
		(circ or rect)	Diameter [mm]	height[mm]	width[mm]	diameter[mm]	[m]	m3/h	m3/h	No.		(circular only)	[-]	dP [Pa]	Item	dP [Pa]	Zeta value[-]	dP [Pa]	(m2)	(m/s)	[Pa]	[Pa]	[Pa]	[Pa]
Overflow	Overflow	rect	0	350	350	350	0,00	1400	1400	1		Normal	0,00	0,00	Rectangular fire damper	10		10	0,1	3,2	0,0	0,0	10,0	10,00
Overpressure	Overpressure															10		10	0,0	-	-	0,0	10,0	10,00
A	Air Terminals	rect	0	350	350	350		1400	1400	1		Normal	0,00	0,00	Mesh Grill	20		20	0,1	3,2	0,0	0,0	20,0	20,00
A	Ducts	rect	0	350	350	350	0,17		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,06
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular balancing damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	0,13		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,0	0,0	0,0	0,04
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular fire damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	0,31		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,10
A	Duct Fittings	rect	0	350	350	350			1400	1	90 Degree Bend	Normal	1,00	6,05				0	0,1	3,2	0,0	6,0	0,0	6,05
A	Ducts	rect	0	350	350	350	0,31		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,10
A	Duct Fittings	rect	0	350	350	350			1400	1	90 Degree Bend	Normal	1,00	6,05				0	0,1	3,2	0,0	6,0	0,0	6,05
A	Ducts	rect	0	350	350	350	2,50		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,8	0,0	0,0	0,82
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular fire damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	4,16		1400	1		Normal	0,00	0,00				0	0,1	3,2	1,4	0,0	0,0	1,36
B	Duct Fittings	rect	0	350	350	350		290	1690	1	In-line	Normal	0,10	0,88				0	0,1	3,8	0,0	0,9	0,0	0,88
B	Ducts	rect	0	350	350	350	84,10		1690	1		Normal	0,00	0,00				0	0,1	3,8	38,6	0,0	0,0	38,62
B	Duct Fittings	rect	0	350	350	350			1690	1	90 Degree Bend	Normal	1,00	8,81				0	0,1	3,8	0,0	8,8	0,0	8,81
B	Ducts	rect	0	350	350	350	12,87		1690	1		Normal	0,00	0,00				0	0,1	3,8	5,9	0,0	0,0	5,91
B	Duct Fittings	rect	0	350	350	350			1690	1	Reducer	Normal	0,10	0,88				0	0,1	3,8	0,0	0,9	0,0	0,88
C	Duct Fittings	rect	0	400	450	424		1400	3090	1	90 Degree Bend	Normal	1,00	13,64				0	0,2	4,8	0,0	13,6	0,0	13,64
C	Ducts	rect	0	400	450	424	0,22		3090	1		Normal	0,00	0,00				0	0,2	4,8	0,1	0,0	0,0	0,12
C	Duct Accessories	rect	0	400	450	424			3090	1	In-line	Normal	0,10	1,36	Rectangular fire damper	10		10	0,2	4,8	0,0	1,4	10,0	11,36
C	Ducts	rect	0	400	450	424	0,51		3090	1		Normal	0,00	0,00				0	0,2	4,8	0,3	0,0	0,0	0,28
C	Duct Fittings	rect	0	400	450	424			3090	1	90 Degree Bend	Normal	1,00	13,64				0	0,2	4,8	0,0	13,6	0,0	13,64
C	Ducts	rect	0	400	450	424	0,70		3090	1		Normal	0,00	0,00				0	0,2	4,8	0,4	0,0	0,0	0,38
D	Duct Fittings	rect	0	400	450	424		50	3140	1	In-line	Normal	0,10	1,41				0	0,2	4,8	0,0	1,4	0,0	1,41
D	Ducts	rect	0	400	450	424	2,19		3140	1		Normal	0,00	0,00				0	0,2	4,8	1,2	0,0	0,0	1,22
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	1,70		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,9	0,0	0,0	0,94
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	3,37		3140	1		Normal	0,00	0,00				0	0,2	4,8	1,9	0,0	0,0	1,87
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	1,27		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,7	0,0	0,0	0,71
D	Duct Fittings	rect	0	400	450	424			3140	1	Reducer	Normal	0,10	1,41				0	0,2	4,8	0,0	1,4	0,0	1,41
D	A1-AHU-1	rect	0	400	450	424			3140	1		Normal	0,00	0,00				0	0,2	4,8	0,0	0,0	0,0	-
																							Sum	**231**
																							Design Margin	**20%**
																						Total:	**[Pa]**	**280**

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	3140	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

A1-AHU-1 Air Return

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	**name**	**Shape**	**Circular**	**Rectangular**		**Hydraulic**	**Length**	**Flowrate added**	**Flowrate**	**Number**	**Bend/branch**	**Type**	**ζ**		**Other items**			**Total**	**c/s/ area**	**Velocity**	**Frictional loss**	**Branch/bend loss**	**Equipment Losses**	**Total**
		(circ or rect)	**Diameter [mm]**	**height[mm]**	**width[mm]**	**diameter[mm]**	**[m]**	**m3/h**	**m3/h**	**No.**		**(circular only)**	**[-]**	**dP [Pa]**	**Item**	**dP [Pa]**	**Zeta value[-]**	**dP [Pa]**	**(m2)**	**(m/s)**	**[Pa]**	**[Pa]**	**[Pa]**	**[Pa]**
A	Air Terminals	rect	0	350	350	350		1400	1400	1		Normal	0,00	0,00	Mesh Grill	20		20	0,1	3,2	0,0	0,0	20,0	20,00
A	Ducts	rect	0	350	350	350	0,30		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,10
A	Duct Accessories	rect	0	350	350	350			1400	1		Normal	0,00	0,00	Rectangular balancing damper	10		10	0,1	3,2	0,0	0,0	10,0	10,00
A	Ducts	rect	0	350	350	350	0.55		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,2	0,0	0,0	0,18
A	Duct Accessories	rect	0	350	350	350			1400	1		Normal	0,00	0,00	Rectangular fire damper	10		10	0,1	3,2	0,0	0,0	10,0	10,00
A	Ducts	rect	0	350	350	350	5.78		1400	1		Normal	0,00	0,00				0	0,1	3,2	1,9	0,0	0,0	1,90
B	Duct Fittings	rect	0	350	350	350		290	1690	1	In-line	Normal	0,10	0,88				0	0,1	3,8	0,0	0,9	0,0	0,88
B	Ducts	rect	0	350	350	350	3,22		1690	1		Normal	0,00	0,00				0	0,1	3,8	1,5	0,0	0,0	1,48
B	Duct Fittings	rect	0	350	350	350			1690	1	45 Degree Bend	Normal	0,70	6,17				0	0,1	3,8	0,0	6,2	0,0	6,17
B	Ducts	rect	0	350	350	350	0,86		1690	1		Normal	0,00	0,00				0	0,1	3,8	0,4	0,0	0,0	0,39
B	Duct Fittings	rect	0	350	350	350			1690	1	45 Degree Bend	Normal	0,70	6,17				0	0,1	3,8	0,0	6,2	0,0	6,17
B	Ducts	rect	0	350	350	350	74,62		1690	1		Normal	0,00	0,00				0	0,1	3,8	34,3	0,0	0,0	34,26
B	Duct Fittings	rect	0	400	450	424			1690	1	Reducer	Normal	0,10	0,41				0	0,2	2,6	0,0	0,4	0,0	0,41
C	Duct Fittings	rect	0	400	450	424		1400	3090	1	In-line	Normal	0,10	1,36				0	0,2	4,8	0,0	1,4	0,0	1,36
C	Ducts	rect	0	400	450	424	3,09		3090	1		Normal	0,00	0,00				0	0,2	4,8	1,7	0,0	0,0	1,67
C	Duct Fittings	rect	0	400	450	424			3090	1	90 Degree Bend	Normal	1,00	13,64				0	0,2	4,8	0,0	13,6	0,0	13,64
C	Ducts	rect	0	400	450	424	13.67		3090	1		Normal	0,00	0,00				0	0,2	4,8	7,4	0,0	0,0	7,38
C	Duct Fittings	rect	0	400	450	424			3090	1	90 Degree Bend	Normal	1,00	13,64				0	0,2	4,8	0,0	13,6	0,0	13,64
C	Ducts	rect	0	400	450	424	0,18		3090	1		Normal	0,00	0,00				0	0,2	4,8	0,1	0,0	0,0	0,10
C	Duct Accessories	rect	0	400	450	424			3090	1	In-line	Normal	0,10	1,36	Rectangular fire damper	10		10	0,2	4,8	0,0	1,4	10,0	11,36
C	Ducts	rect	0	400	450	424	0,28		3090	1		Normal	0,00	0,00				0	0,2	4,8	0,2	0,0	0,0	0,15
D	Duct Fittings	rect	0	400	450	424		50	3140	1	In-line	Normal	0,10	1,41				0	0,2	4,8	0,0	1,4	0,0	1,41
D	Ducts	rect	0	400	450	424	0,25		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,1	0,0	0,0	0,14
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	2,29		3140	1		Normal	0,00	0,00				0	0,2	4,8	1,3	0,0	0,0	1,27
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	2,29		3140	1		Normal	0,00	0,00				0	0,2	4,8	1,3	0,0	0,0	1,27
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	1,56		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,9	0,0	0,0	0,87
D	Duct Fittings	rect	0	400	450	424			3140	1	45 Degree Bend	Normal	0,70	9,86				0	0,2	4,8	0,0	9,9	0,0	9,86
D	Ducts	rect	0	400	450	424	0,98		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,5	0,0	0,0	0,54
D	Duct Fittings	rect	0	400	450	424			3140	1	45 Degree Bend	Normal	0,70	9,86				0	0,2	4,8	0,0	9,9	0,0	9,86
D	Ducts	rect	0	400	450	424	1,45		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,8	0,0	0,0	0,81
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	2,64		3140	1		Normal	0,00	0,00				0	0,2	4,8	1,5	0,0	0,0	1,47
D	Duct Fittings	rect	0	400	450	424			3140	1	Reducer	Normal	0,10	1,41				0	0,2	4,8	0,0	1,4	0,0	1,41
	A1-AHU-1								3140	1		Normal	0,00	-				0	0,0	-	-	-	0,0	-
D	Duct Fittings	rect	0	400	450	424			3140	1	Reducer	Normal	0,10	1,41				0	0,2	4,8	0,0	1,4	0,0	1,41
D	Ducts	rect	0	400	450	424	0,35		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,2	0,0	0,0	0,19
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	1,00		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,6	0,0	0,0	0,56
D	Duct Fittings	rect	0	400	450	424			3140	1	90 Degree Bend	Normal	1,00	14,09				0	0,2	4,8	0,0	14,1	0,0	14,09
D	Ducts	rect	0	400	450	424	3.94		3140	1		Normal	0,00	0,00				0	0,2	4,8	2,2	0,0	0,0	2,19
D	Duct Fittings	rect	0	400	450	424			3140	1	45 Degree Bend	Normal	0,70	9,86				0	0,2	4,8	0,0	9,9	0,0	9,86
D	Ducts	rect	0	400	450	424	0,32		3140	1		Normal	0,00	0,00				0	0,2	4,8	0,2	0,0	0,0	0,18
D	Air Terminals	rect	0	400	450	424			3140	1		Normal	0,00	0,00	Mesh Grill	20		20	0,2	4,8	0,0	0,0	20,0	20,00
																							Sum	**289**
																							Design Margin	**20%**
																						Total:	**[Pa]**	**350**

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	2950	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

A2-AHU-1 Air Supply

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	name	Shape	Circular	Rectangular		Hydraulic	Length	Flowrate added	Flowrate	Number	Bend/branch	Type	ζ		Other items			Total	c/s/ area	Velocity	Frictional loss	Branch/bend loss	Equipment Losses	Total
		(circ or rect)	Diameter [mm]	height[mm]	width[mm]	diameter[mm]	[m]	m3/h	m3/h	No.		(circular only)	[-]	dP [Pa]	Item	dP [Pa]	Zeta value[-]	dP [Pa]	(m2)	(m/s)	[Pa]	[Pa]	[Pa]	[Pa]
Overflow	Overflow	rect	0	350	350	350	0,00	1400	1400	1		Normal	0,00	0,00	Rectangular fire damper	10		10	0,1	3,2	0,0	0,0	10,0	10,00
Overpressure	Overpressure															10		10	0,0	-	-	0,0	10,0	10,00
A	Air Terminals	rect	0	350	350	350		1400	1400	1		Normal	0,00	0,00	Mesh Grill	20		20	0,1	3,2	0,0	0,0	20,0	20,00
A	Ducts	rect	0	350	350	350	0,17		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,06
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular balancing damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	0,13		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,0	0,0	0,0	0,04
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular fire damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	1,06		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,3	0,0	0,0	0,35
A	Duct Fittings	rect	0	350	350	350			1400	1	90 Degree Bend	Normal	1,00	6,05				0	0,1	3,2	0,0	6,0	0,0	6,05
A	Ducts	rect	0	350	350	350	8,87		1400	1		Normal	0,00	0,00				0	0,1	3,2	2,9	0,0	0,0	2,91
A	Duct Fittings	rect	0	350	350	350			1400	1	45 Degree Bend	Normal	0,70	4,23				0	0,1	3,2	0,0	4,2	0,0	4,23
A	Ducts	rect	0	350	350	350	0,53		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,2	0,0	0,0	0,17
B	Duct Fittings	rect	0	350	350	350		50	1450	1	In-line	Normal	0,10	0,65				0	0,1	3,3	0,0	0,6	0,0	0,65
B	Ducts	rect	0	350	350	350	0,39		1450	1		Normal	0,00	0,00				0	0,1	3,3	0,1	0,0	0,0	0,14
B	Duct Fittings	rect	0	350	350	350			1450	1	45 Degree Bend	Normal	0,70	4,54				0	0,1	3,3	0,0	4,5	0,0	4,54
B	Ducts	rect	0	350	350	350	3,81		1450	1		Normal	0,00	0,00				0	0,1	3,3	1,3	0,0	0,0	1,33
B	Duct Accessories	rect	0	350	350	350			1450	1	In-line	Normal	0,10	0,65	Rectangular fire damper	10		10	0,1	3,3	0,0	0,6	10,0	10,65
B	Ducts	rect	0	350	350	350	3,12		1450	1		Normal	0,00	0,00				0	0,1	3,3	1,1	0,0	0,0	1,09
B	Duct Fittings	rect	0	350	350	350			1450	1	45 Degree Bend	Normal	0,70	4,54				0	0,1	3,3	0,0	4,5	0,0	4,54
B	Ducts	rect	0	350	350	350	0,86		1450	1		Normal	0,00	0,00				0	0,1	3,3	0,3	0,0	0,0	0,30
B	Duct Fittings	rect	0	350	350	350			1450	1	45 Degree Bend	Normal	0,70	4,54	Rectangular fire damper	10		10	0,1	3,3	0,0	4,5	10,0	14,54
B	Ducts	rect	0	350	350	350	75,10		1450	1		Normal	0,00	0,00				0	0,1	3,3	26,2	0,0	0,0	26,23
B	Duct Fittings	rect	0	350	350	350			1450	1	90 Degree Bend	Normal	1,00	6,49				0	0,1	3,3	0,0	6,5	0,0	6,49
B	Ducts	rect	0	350	350	350	13,30		1450	1		Normal	0,00	0,00				0	0,1	3,3	4,6	0,0	0,0	4,64
B	Duct Fittings	rect	0	350	350	350			1450	1	Reducer	Normal	0,10	0,65				0	0,1	3,3	0,0	0,6	0,0	0,65
C	Duct Fittings	rect	0	400	450	424		1450	2900	1	90 Degree Bend	Normal	1,00	12,02				0	0,2	4,5	0,0	12,0	0,0	12,02
C	Ducts	rect	0	400	450	424	0,30		2900	1		Normal	0,00	0,00				0	0,2	4,5	0,1	0,0	0,0	0,14
C	Duct Accessories	rect	0	400	450	424			2900	1	In-line	Normal	0,10	1,20				0	0,2	4,5	0,0	1,2	0,0	1,20
C	Ducts	rect	0	400	450	424	0,50		2900	1		Normal	0,00	0,00				0	0,2	4,5	0,2	0,0	0,0	0,24
C	Duct Fittings	rect	0	400	450	424			2900	1	90 Degree Bend	Normal	1,00	12,02				0	0,2	4,5	0,0	12,0	0,0	12,02
C	Ducts	rect	0	400	450	424	0,10		2900	1		Normal	0,00	0,00				0	0,2	4,5	0,0	0,0	0,0	0,05
D	Duct Fittings	rect	0	400	450	424		50	2950	1	In-line	Normal	0,10	1,24				0	0,2	4,6	0,0	1,2	0,0	1,24
D	Ducts	rect	0	400	450	424	2,80		2950	1		Normal	0,00	0,00				0	0,2	4,6	1,4	0,0	0,0	1,39
D	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
D	Ducts	rect	0	400	450	424	4,81		2950	1		Normal	0,00	0,00				0	0,2	4,6	2,4	0,0	0,0	2,39
D	Duct Fittings	rect	0	400	450	424			2950	1	Reducer	Normal	0,10	1,24				0	0,2	4,6	0,0	1,2	0,0	1,24
D	A2-AHU-1	rect	0	400	450	424			2950	1		Normal	0,00	0,00				0	0,2	4,6	0,0	0,0	0,0	-
																							Sum	195
																							Design Margin	20%
																						Total:	[Pa]	240

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	2950	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

A2-AHU-1 Air Return

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	name	Shape	Circular	Rectangular		Hydraulic	Length	Flowrate added	Flowrate	Number	Bend/branch	Type	ζ		Other items			Total	c/s/ area	Velocity	Frictional loss	Branch/bend loss	Equipment Losses	Total
		(circ or rect)	Diameter [mm]	height[mm]	width[mm]	diameter[mm]	[m]	m3/h	m3/h	No.		(circular only)	[-]	dP [Pa]	Item	dP [Pa]	Zeta value[-]	dP [Pa]	(m2)	(m/s)	[Pa]	[Pa]	[Pa]	[Pa]
A	Air Terminals	rect	0	350	350	350			1400	1		Normal	0,00	0,00	Mesh Grill	20		20	0,1	3,2	0,0	0,0	20,0	20,00
A	Ducts	rect	0	350	350	350	0,32		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,10
A	Duct Accessories	rect	0	350	350	350			1400	1	In-line	Normal	0,10	0,60	Rectangular balancing damper	10		10	0,1	3,2	0,0	0,6	10,0	10,60
A	Ducts	rect	0	350	350	350	0,16		1400	1		Normal	0,00	0,00				0	0,1	3,2	0,1	0,0	0,0	0,05
B	Duct Fittings	rect	0	350	350	350		50	1450	1	In-line	Normal	0,10	0,65				0	0,1	3,3	0,0	0,6	0,0	0,65
B	Ducts	rect	0	350	350	350	4,23		1450	1		Normal	0,00	0,00				0	0,1	3,3	1,5	0,0	0,0	1,48
B	Duct Accessories	rect	0	350	350	350			1450	1	In-line	Normal	0,10	0,65	Rectangular fire damper	10		10	0,1	3,3	0,0	0,6	10,0	10,65
B	Ducts	rect	0	350	350	350	67,65		1450	1		Normal	0,00	0,00				0	0,1	3,3	23,6	0,0	0,0	23,63
B	Duct Fittings	rect	0	350	350	350			1450	1	Reducer	Normal	0,10	0,65				0	0,1	3,3	0,0	0,6	0,0	0,65
C	Duct Fittings	rect	0	400	450	424		1400	2850	1	In-line	Normal	0,10	1,16				0	0,2	4,4	0,0	1,2	0,0	1,16
C	Ducts	rect	0	400	450	424	11,91		2850	1		Normal	0,00	0,00				0	0,2	4,4	5,6	0,0	0,0	5,56
C	Duct Fittings	rect	0	400	450	424			2850	1	90 Degree Bend	Normal	1,00	11,61				0	0,2	4,4	0,0	11,6	0,0	11,61
C	Ducts	rect	0	400	450	424	13,90		2850	1		Normal	0,00	0,00				0	0,2	4,4	6,5	0,0	0,0	6,49
C	Duct Fittings	rect	0	400	450	424			2850	1	90 Degree Bend	Normal	1,00	11,61				0	0,2	4,4	0,0	11,6	0,0	11,61
C	Ducts	rect	0	400	450	424	0,19		2850	1		Normal	0,00	0,00				0	0,2	4,4	0,1	0,0	0,0	0,09
C	Duct Accessories	rect	0	400	450	424			2850	1	In-line	Normal	0,10	1,16	Rectangular fire damper	10		10	0,2	4,4	0,0	1,2	10,0	11,16
C	Ducts	rect	0	400	450	424	0,07		2850	1		Normal	0,00	0,00				0	0,2	4,4	0,0	0,0	0,0	0,03
D	Duct Fittings	rect	0	400	450	424		50	2900	1	In-line	Normal	0,10	1,20				0	0,2	4,5	0,0	1,2	0,0	1,20
C	Ducts	rect	0	400	450	424	0,45		2900	1		Normal	0,00	0,00				0	0,2	4,5	0,2	0,0	0,0	0,22
C	Duct Fittings	rect	0	400	450	424			2900	1	90 Degree Bend	Normal	1,00	12,02				0	0,2	4,5	0,0	12,0	0,0	12,02
C	Ducts	rect	0	400	450	424	0,34		2900	1		Normal	0,00	0,00				0	0,2	4,5	0,2	0,0	0,0	0,16
E	Duct Fittings	rect	0	400	450	424		50	2950	1	In-line	Normal	0,10	1,24				0	0,2	4,6	0,0	1,2	0,0	1,24
E	Ducts	rect	0	400	450	424	1,97		2950	1		Normal	0,00	0,00				0	0,2	4,6	1,0	0,0	0,0	0,98
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	2,21		2950	1		Normal	0,00	0,00				0	0,2	4,6	1,1	0,0	0,0	1,10
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	0,26		2950	1		Normal	0,00	0,00				0	0,2	4,6	0,1	0,0	0,0	0,13
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	0,09		2950	1		Normal	0,00	0,00				0	0,2	4,6	0,0	0,0	0,0	0,04
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	3,95		2950	1		Normal	0,00	0,00				0	0,2	4,6	2,0	0,0	0,0	1,96
E	Duct Fittings	rect	0	400	450	424			2950	1	Reducer	Normal	0,10	1,24				0	0,2	4,6	0,0	1,2	0,0	1,24
	A2-AHU-1								2950	1		Normal	0,00	-				0	0,0	-	-	-	0,0	-
E	Duct Fittings	rect	0	400	450	424			2950	1	Reducer	Normal	0,10	1,24				0	0,2	4,6	0,0	1,2	0,0	1,24
E	Ducts	rect	0	400	450	424	0,31		2950	1		Normal	0,00	0,00				0	0,2	4,6	0,2	0,0	0,0	0,15
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	1,00		2950	1		Normal	0,00	0,00				0	0,2	4,6	0,5	0,0	0,0	0,50
E	Duct Fittings	rect	0	400	450	424			2950	1	90 Degree Bend	Normal	1,00	12,43				0	0,2	4,6	0,0	12,4	0,0	12,43
E	Ducts	rect	0	400	450	424	2,04		2950	1		Normal	0,00	0,00				0	0,2	4,6	1,0	0,0	0,0	1,01
E	Duct Fittings	rect	0	400	450	424			2950	1	45 Degree Bend	Normal	0,70	8,70				0	0,2	4,6	0,0	8,7	0,0	8,70
E	Ducts	rect	0	400	450	424	0,32		2950	1		Normal	0,00	0,00				0	0,2	4,6	0,2	0,0	0,0	0,16
E	Air Terminals	rect	0	400	450	424			2950	1		Normal	0,00	0,00	Mesh Grill	20		20	0,2	4,6	0,0	0,0	20,0	20,00
																							Sum	**242**

	Design Margin	**20%**
Total:	**[Pa]**	**300**

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	4010	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

AF-AHU-1 Air Return

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	name	Shape	Circular	Rectangular		Hydraulic	Length	Flowrate added	Flowrate	Number	Bend/branch	Type	ζ		Other items			Total	c/s/ area	Velocity	Frictional loss	Branch/bend loss	Equipment Losses	Total
		(circ or rect)	Diameter [mm]	height[mm]	width[mm]	diameter[mm]	[m]	m3/h	m3/h	No.		(circular only)	[-]	dP [Pa]	Item	dP [Pa]	Zeta value[-]	dP [Pa]	(m2)	(m/s)	[Pa]	[Pa]	[Pa]	[Pa]
A	Air Terminals	circ	100			100			50	1		Normal	0,00	0,00	Mesh Grill	20		20	0,0	1,8	0,0	0,0	20,0	20,00
A	Flex Ducts	circ	100			100	0,17		50	1		Normal	0,00	0,00		5		5	0,0	1,8	0,1	0,0	5,0	5,09
A	Duct Accessories	circ	100			100			50	1	In-line	Normal	0,04	0,08	Rectangular balancing damper	10		10	0,0	1,8	0,0	0,1	10,0	10,08
A	Ducts	circ	100			100	3,21		50	1		Normal	0,00	0,00				0	0,0	1,8	1,8	0,0	0,0	1,78
A	Duct Fittings	circ	100			100			50	1	Reducer	Normal	0,10	0,19				0	0,0	1,8	0,0	0,2	0,0	0,19
B	Duct Fittings	circ	160			160		130	180	1	In-line	Normal	0,04	0,15				0	0,0	2,5	0,0	0,1	0,0	0,15
B	Ducts	circ	160			160	2,68		180	1		Normal	0,00	0,00				0	0,0	2,5	1,5	0,0	0,0	1,49
B	Duct Fittings	circ	160			160			180	1	Reducer	Normal	0,10	0,37				0	0,0	2,5	0,0	0,4	0,0	0,37
C	Duct Fittings	circ	160			160		160	340	1	In-line	Normal	0,04	0,53				0	0,0	4,7	0,0	0,5	0,0	0,53
C	Ducts	circ	200			200	3,52		340	1		Normal	0,00	0,00				0	0,0	3,0	2,1	0,0	0,0	2,08
D	Duct Fittings	circ	200			200		100	440	1	Reducer	Normal	0,10	0,91				0	0,0	3,9	0,0	0,9	0,0	0,91
D	Duct Fittings	circ	250			250			440	1	In-line	Normal	0,04	0,15				0	0,0	2,5	0,0	0,1	0,0	0,15
D	Ducts	circ	250			250	1,69		440	1		Normal	0,00	0,00				0	0,0	2,5	0,5	0,0	0,0	0,54
E	Duct Fittings	circ	250			250		50	490	1	90 Degree Bend	Normal	0,25	1,15				0	0,0	2,8	0,0	1,2	0,0	1,15
E	Ducts	circ	250			250	3,60		490	1		Normal	0,00	0,00				0	0,0	2,8	1,4	0,0	0,0	1,40
E	Duct Fittings	circ	250			250			490	1	Reducer	Normal	0,10	0,46				0	0,0	2,8	0,0	0,5	0,0	0,46
F	Duct Fittings	rect		250	250	250		80	570	1	In-line	Normal	0,10	0,39				0	0,1	2,5	0,0	0,4	0,0	0,39
F	Ducts	rect		250	250	250	4,10		570	1		Normal	0,00	0,00				0	0,1	2,5	1,4	0,0	0,0	1,36
G	Duct Fittings	rect		250	250	250		50	620	1	In-line	Normal	0,10	0,46				0	0,1	2,8	0,0	0,5	0,0	0,46
G	Ducts	rect		250	250	250	4,10		620	1		Normal	0,00	0,00				0	0,1	2,8	1,6	0,0	0,0	1,58
G	Duct Fittings	rect		250	250	250			620	1	90 Degree Bend	Normal	1,00	4,56				0	0,1	2,8	0,0	4,6	0,0	4,56
G	Ducts	rect		250	250	250	1,68		620	1		Normal	0,00	0,00				0	0,1	2,8	0,6	0,0	0,0	0,65
G	Duct Fittings	rect		250	250	250			620	1	Reducer	Normal	0,10	0,46				0	0,1	2,8	0,0	0,5	0,0	0,46
H	Duct Fittings	rect		350	400	373		1110	1730	1	90 Degree Bend	Normal	1,00	7,07				0	0,1	3,4	0,0	7,1	0,0	7,07
H	Ducts	rect		350	400	373	0,48		1730	1		Normal	0,00	0,00				0	0,1	3,4	0,2	0,0	0,0	0,17
I	Duct Fittings	rect		350	400	373		220	1950	1	In-line	Normal	0,10	0,90				0	0,1	3,9	0,0	0,9	0,0	0,90
I	Ducts	rect		350	400	373	8,10		1950	1		Normal	0,00	0,00				0	0,1	3,9	3,5	0,0	0,0	3,50
I	Duct Fittings	rect		350	400	373			1950	1	Reducer	Normal	0,10	0,90				0	0,1	3,9	0,0	0,9	0,0	0,90
J	Duct Fittings	rect		400	400	400		270	2220	1	In-line	Normal	0,10	0,89				0	0,2	3,9	0,0	0,9	0,0	0,89
J	Ducts	rect		400	400	400	0,39		2220	1		Normal	0,00	0,00				0	0,2	3,9	0,2	0,0	0,0	0,15
J	Duct Fittings	rect		400	400	400			2220	1	90 Degree Bend	Normal	1,00	8,91				0	0,2	3,9	0,0	8,9	0,0	8,91
J	Ducts	rect		400	400	400	0,07		2220	1		Normal	0,00	0,00				0	0,2	3,9	0,0	0,0	0,0	0,03
J	Duct Accessories	rect		400	400	400			2220	1		Normal	0,00	0,00	Rectangular fire damper	10		10	0,2	3,9	0,0	0,0	10,0	10,00
J	Ducts	rect		400	400	400	0,27		2220	1		Normal	0,00	0,00				0	0,2	3,9	0,1	0,0	0,0	0,11
J	Duct Fittings	rect		400	400	400			2220	1	90 Degree Bend	Normal	1,00	8,91				0	0,2	3,9	0,0	8,9	0,0	8,91
J	Ducts	rect		400	400	400	0,07		2220	1		Normal	0,00	0,00				0	0,2	3,9	0,0	0,0	0,0	0,03
K	Duct Fittings	rect		400	400	400		350	2570	1	In-line	Normal	0,10	1,19				0	0,2	4,5	0,0	1,2	0,0	1,19
K	Ducts	rect		400	400	400	4,83		2570	1		Normal	0,00	0,00				0	0,2	4,5	2,5	0,0	0,0	2,48
K	Duct Fittings	rect		400	400	400			2570	1	Reducer	Normal	0,10	1,19				0	0,2	4,5	0,0	1,2	0,0	1,19
L	Duct Fittings	rect		450	450	450		1390,00	3960	1	In-line	Normal	0,10	1,77				0	0,2	5,4	0,0	1,8	0,0	1,77
L	Ducts	rect		450	450	450	1,05		3960	1		Normal	0,00	0,00				0	0,2	5,4	0,7	0,0	0,0	0,67
M	Duct Fittings	rect		450	450	450		50,00	4010	1	In-line	Normal	0,10	1,82				0	0,2	5,5	0,0	1,8	0,0	1,82
M	Ducts	rect		450	450	450	1,18		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,8	0,0	0,0	0,77
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	2,07		4010	1		Normal	0,00	0,00				0	0,2	5,5	1,3	0,0	0,0	1,34
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	1,08		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,7	0,0	0,0	0,70
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	0,31		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,2	0,0	0,0	0,20
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	1,65		4010	1		Normal	0,00	0,00				0	0,2	5,5	1,1	0,0	0,0	1,07
M	Duct Fittings	rect		450	450	450			4010	1	Reducer	Normal	0,10	1,82				0	0,2	5,5	0,0	1,8	0,0	1,82
M	AF-AHU-1					-			4010	1		Normal	0,00	-				0	0,0	-	-	-	0,0	-
M	Duct Fittings	rect		450	450	450			4010	1	Reducer	Normal	0,10	1,82				0	0,2	5,5	0,0	1,8	0,0	1,82
M	Ducts	rect		450	450	450	0,64		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,4	0,0	0,0	0,42
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	1,12		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,7	0,0	0,0	0,73
M	Duct Fittings	rect		450	450	450			4010	1	90 Degree Bend	Normal	1,00	18,15				0	0,2	5,5	0,0	18,2	0,0	18,15
M	Ducts	rect		450	450	450	2,46		4010	1		Normal	0,00	0,00				0	0,2	5,5	1,6	0,0	0,0	1,60
M	Duct Fittings	rect		450	450	450			4010	1	45 Degree Bend	Normal	0,70	12,71				0	0,2	5,5	0,0	12,7	0,0	12,71
M	Ducts	rect		450	450	450	0,27		4010	1		Normal	0,00	0,00				0	0,2	5,5	0,2	0,0	0,0	0,18
M	Air Terminals	rect		450	450	450			4010	1		Normal	0,00	0,00	Mesh Grill	20		20	0,2	5,5	0,0	0,0	20,0	20,00
																							Sum	**259**
																							Design Margin	**20%**
																						Total:	**[Pa]**	**320**

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Ventilation Systems - AHUs Pressure Drop
Document ID	MIL07-DBA-ZZ-XX-CA-M-57022
Date	07.11.2025
Revision	P01

Parameters		
AHU flow rate:	5400	m3/h
Density	1,2	[kg/m3]
Kinematic viscosity	1,50E-05	[m2/s]
Epsilon Duct:	0,00015	m
Re < 2300	Laminar	
Re > 3500	Turbulent	

Calculation to be finalized after equipments

AF-AHU-1 Air Return

Duct and Geometrical Data						General Data				Bend + branch			Equipment pressure drops					Calculated Data						
Section	name	Shape	Circular	Rectangular		Hydraulic	Length	Flowrate added	Flowrate	Number	Bend/branch	Type	ζ		Other items			Total	c/s/ area	Velocity	Frictional loss	Branch/bend loss	Equipment Losses	Total
		(circ or rect)	Diameter [mm]	height[mm]	width[mm]	diameter[mm]	[m]	m3/h	m3/h	No.		(circular only)	[-]	dP [Pa]	Item	dP [Pa]	Zeta value[-]	dP [Pa]	(m2)	(m/s)	[Pa]	[Pa]	[Pa]	[Pa]
A	Air Terminals	circ	100			100		50	50	1		Normal	0,00	0,00	Mesh Grill	20		20	0,0	1,8	0,0	0,0	20,0	20,00
A	Flex Ducts	circ	100			100	0,11		50	1		Normal	0,00	0,00		5		5	0,0	1,8	0,1	0,0	5,0	5,06
A	Duct Accessories	circ	100			100			50	1	In-line	Normal	0,04	0,08	Rectangular balancing damper	10		10	0,0	1,8	0,0	0,1	10,0	10,08
A	Ducts	circ	100			100	1,57		50	1		Normal	0,00	0,00				0	0,0	1,8	0,9	0,0	0,0	0,87
A	Duct Fittings	circ	100			100			50	1	90 Degree Bend	Normal	0,25	0,47				0	0,0	1,8	0,0	0,5	0,0	0,47
A	Ducts	circ	100			100	2,07		50	1		Normal	0,00	0,00				0	0,0	1,8	1,1	0,0	0,0	1,15
A	Duct Fittings	circ	100			100			50	1	Reducer	Normal	0,10	0,19				0	0,0	1,8	0,0	0,2	0,0	0,19
B	Duct Fittings	circ	125			125		50	100	1	In-line	Normal	0,04	0,12				0	0,0	2,3	0,0	0,1	0,0	0,12
B	Ducts	circ	125			125	1,96		100	1		Normal	0,00	0,00				0	0,0	2,3	1,3	0,0	0,0	1,26
B	Duct Fittings	circ	125			125			100	1	Reducer	Normal	0,10	0,31				0	0,0	2,3	0,0	0,3	0,0	0,31
C	Duct Fittings	circ	200			200		180	280	1	In-line	Normal	0,04	0,15				0	0,0	2,5	0,0	0,1	0,0	0,15
C	Ducts	circ	200			200	1,24		280	1		Normal	0,00	0,00				0	0,0	2,5	0,5	0,0	0,0	0,52
C	Duct Fittings	circ	200			200			280	1	Reducer	Normal	0,10	0,37				0	0,0	2,5	0,0	0,4	0,0	0,37
D	Duct Fittings	circ	250			250		160	440	1	In-line	Normal	0,04	0,15				0	0,0	2,5	0,0	0,1	0,0	0,15
D	Ducts	circ	250			250	3,30		440	1		Normal	0,00	0,00				0	0,0	2,5	1,1	0,0	0,0	1,06
E	Duct Fittings	circ	250			250		100	540	1	In-line	Normal	0,04	0,22				0	0,0	3,1	0,0	0,2	0,0	0,22
E	Ducts	circ	250			250	3,15		540	1		Normal	0,00	0,00				0	0,0	3,1	1,5	0,0	0,0	1,46
F	Duct Fittings	circ	250			250		50	590	1	90 Degree Bend	Normal	0,25	1,67				0	0,0	3,3	0,0	1,7	0,0	1,67
F	Ducts	circ	250			250	0,83		590	1		Normal	0,00	0,00				0	0,0	3,3	0,4	0,0	0,0	0,45
F	Duct Fittings	circ	250			250			590	1	Reducer	Normal	0,10	0,67				0	0,0	3,3	0,0	0,7	0,0	0,67
G	Duct Fittings	rect		250	250	250		80	670	1	In-line	Normal	0,10	0,53				0	0,1	3,0	0,0	0,5	0,0	0,53
G	Ducts	rect		250	250	250	6,32		670	1		Normal	0,00	0,00				0	0,1	3,0	2,8	0,0	0,0	2,79
H	Duct Fittings	rect		250	250	250		50	720	1	In-line	Normal	0,10	0,61				0	0,1	3,2	0,0	0,6	0,0	0,61
H	Ducts	rect		250	250	250	3,12		720	1		Normal	0,00	0,00				0	0,1	3,2	1,6	0,0	0,0	1,56
H	Duct Fittings	rect		250	250	250			720	1	90 Degree Bend	Normal	1,00	6,14				0	0,1	3,2	0,0	6,1	0,0	6,14
H	Ducts	rect		250	250	250	1,68		720	1		Normal	0,00	0,00				0	0,1	3,2	0,8	0,0	0,0	0,84
H	Duct Fittings	rect		250	250	250			720	1	Reducer	Normal	0,10	0,61				0	0,1	3,2	0,0	0,6	0,0	0,61
I	Duct Fittings	rect		350	400	373		1630	2350	1	90 Degree Bend	Normal	1,00	13,04				0	0,1	4,7	0,0	13,0	0,0	13,04
I	Ducts	rect		350	400	373	4,18		2350	1		Normal	0,00	0,00				0	0,1	4,7	2,5	0,0	0,0	2,52
I	Duct Fittings	rect		350	400	373			2350	1	Reducer	Normal	0,10	1,30				0	0,1	4,7	0,0	1,3	0,0	1,30
J	Duct Fittings	rect		400	400	400		220	2570	1	In-line	Normal	0,10	1,19				0	0,2	4,5	0,0	1,2	0,0	1,19
J	Ducts	rect		400	400	400	2,25		2570	1		Normal	0,00	0,00				0	0,2	4,5	1,2	0,0	0,0	1,15
K	Duct Fittings	rect		400	400	400		60	2630	1	In-line	Normal	0,10	1,25				0	0,2	4,6	0,0	1,3	0,0	1,25
K	Ducts	rect		400	400	400	2,32		2630	1		Normal	0,00	0,00				0	0,2	4,6	1,2	0,0	0,0	1,24
K	Duct Fittings	rect		400	400	400			2630	1	Reducer	Normal	0,10	1,25				0	0,2	4,6	0,0	1,3	0,0	1,25
L	Duct Fittings	rect		450	400	424		140	2770	1	In-line	Normal	0,10	1,10				0	0,2	4,3	0,0	1,1	0,0	1,10
L	Duct	rect		450	400	424	0,73		2770	1		Normal	0,00	0,00				0	0,2	4,3	0,3	0,0	0,0	0,32
M	Duct Fittings	rect		450	400	424		70	2840	1	In-line	Normal	0,10	1,15				0	0,2	4,4	0,0	1,2	0,0	1,15
M	Ducts	rect		450	400	424	0,46		2840	1		Normal	0,00	0,00				0	0,2	4,4	0,2	0,0	0,0	0,21
M	Duct Fittings	rect		450	400	424			2840	1	90 Degree Bend	Normal	1,00	11,52				0	0,2	4,4	0,0	11,5	0,0	11,52
M	Ducts	rect		450	400	424	0,03		2840	1		Normal	0,00	0,00				0	0,2	4,4	0,0	0,0	0,0	0,01
M	Duct Accessories	rect		450	400	424			2840	1	In-line	Normal	0,10	1,15	Rectangular fire damper	10		10	0,2	4,4	0,0	1,2	10,0	11,15
M	Ducts	rect		450	400	424	0,73		2840	1		Normal	0,00	0,00				0	0,2	4,4	0,3	0,0	0,0	0,34
N	Duct Fittings	rect		450	400	424		50,00	2890	1	In-line	Normal	0,10	1,19				0	0,2	4,5	0,0	1,2	0,0	1,19
N	Ducts	rect		450	400	424	0,34		2890	1		Normal	0,00	0,00				0	0,2	4,5	0,2	0,0	0,0	0,16
N	Duct Fittings	rect		450	400	424			2890	1	90 Degree Bend	Normal	1,00	11,93				0	0,2	4,5	0,0	11,9	0,0	11,93
N	Ducts	rect		450	400	424	0,69		2890	1		Normal	0,00	0,00				0	0,2	4,5	0,3	0,0	0,0	0,33
O	Duct Fittings	rect		450	400	424		300,00	3190	1	In-line	Normal	0,10	1,45				0	0,2	4,9	0,0	1,5	0,0	1,45
O	Ducts	rect		450	400	424	5,10		3190	1		Normal	0,00	0,00				0	0,2	4,9	2,9	0,0	0,0	2,92
O	Duct Fittings	rect		450	400	424			3190	1	Reducer	Normal	0,10	1,45				0	0,2	4,9	0,0	1,5	0,0	1,45
P	Duct Fittings	rect		500	550	524		2210,00	5400	1	In-line	Normal	0,10	1,79				0	0,3	5,5	0,0	1,8	0,0	1,79
P	Ducts	rect		500	550	524	1,82		5400	1		Normal	0,00	0,00				0	0,3	5,5	1,0	0,0	0,0	0,97
P	Duct Fittings	rect		500	550	524			5400	1	90 Degree Bend	Normal	1,00	17,85				0	0,3	5,5	0,0	17,9	0,0	17,85
P	Ducts	rect		500	550	524	0,21		5400	1		Normal	0,00	0,00				0	0,3	5,5	0,1	0,0	0,0	0,11
P	Duct Fittings	rect		500	550	524			5400	1	90 Degree Bend	Normal	1,00	17,85				0	0,3	5,5	0,0	17,9	0,0	17,85
P	Ducts	rect		500	550	524	2,04		5400	1		Normal	0,00	0,00				0	0,3	5,5	1,1	0,0	0,0	1,09
P	Duct Fittings	rect		500	550	524			5400	1	45 Degree Bend	Normal	0,70	12,50				0	0,3	5,5	0,0	12,5	0,0	12,50
P	Ducts	rect		500	550	524	0,65		5400	1		Normal	0,00	0,00				0	0,3	5,5	0,3	0,0	0,0	0,35
P	Duct Fittings	rect		500	550	524			5400	1	45 Degree Bend	Normal	0,70	12,50				0	0,3	5,5	0,0	12,5	0,0	12,50
P	Ducts	rect		500	550	524	1,15		5400	1		Normal	0,00	0,00				0	0,3	5,5	0,6	0,0	0,0	0,61
P	Duct Fittings	rect		500	550	524			5400	1	Reducer	Normal	0,10	1,79				0	0,3	5,5	0,0	1,8	0,0	1,79
P	AF-AHU-1					-			5400	1		Normal	0,00	-				0	0,0	-	-	-	0,0	-
																							Sum	**195**
																							Design Margin	**20%**
																						Total:	**[Pa]**	**240**

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-57023

13038001

Title:

Calculation
Smoke Extraction Systems
Data Hall System Sizing

PD0 - RIBA 3	**ITM**	**57023**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	CC	GR	SB	07.11.2025	PD0 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Smoke Extraction Systems - Data Hall System Sizing
Document ID	MIL07-DBA-ZZ-XX-CA-M-57023
Date	7-11-2025
Revision	P01

UNI 9494 - Appendix H

Description	[Value]	[UM]	Remarks
Design Data			
Area	1.580	mq	
Room height	6,2	m	
Min. smoke extraction flow rate per square meter	1,0	m/s * 100mq	According to UNI9494 - Appendix H
Location	Siziano	[-]	
Province	Pavia	[-]	
Automatic fire detection system that automatically activates smoke extraction	Yes	[-]	With a 10 minutes delay after sprinkler activation
Automatic fire detection system that transmits an alarm to a room manned 24h by personnel capable of responding appropriately	Yes	[-]	
Occupied 24 hours a day by personnel non capable of responding appropriately	No	[-]	
Fire hazard groups	HHP	[-]	High hazard, design choice
Presence of automatic control or extinguishing system in the building	Yes	[-]	
Height of stored materials greater than 1.5 m	No	[-]	
Smoke-free air layer height	2,50	m	
System Airflow Calculation			
Alarm time (t_1)	0	min	6.6.2 UNI9494
Intervention time (t_2)	5	min	6.6.3 UNI9494
Fire development time (t)	5	min	0 < t <= 5
Fire propagation speed	High	[-]	
Size group	2	[-]	Table 1 UNI9494
Maximum flow rate	46.000	mc/h	According to UNI9494 - Appendix H
Calculated flow rate	56.900	mc/h	
Extraction flow rate	**46.000**	**mc/h**	

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-SH-M-50700

13038001

Title:

Schedule
Mechanical and Plumbing
Main Equipements

PD0 - RIBA 3	**ITM**	**50700**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	CC	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Schedule - Mechanical and Plumbing - Main Equipements
Document ID	MIL07-DBA-ZZ-XX-SH-M-50700
Date	7-11-2025
Revision	P01

Discipline	Spec Code	Description	Manufacturer	Location	Number	Critical/Non critical	Redundancy	Unit power	Electrical power kW	Note
Cooling	CHL	Air cooled chiller	Carrier	Chillers Platform	14	Critical	N+2	400/3/50	320	OFCI; 1220 kW
Cooling	PPU	Chiller water pump		On board of chiller	14	Critical	N+2	400/3/50	20	Part of chiller OFCI package, supplied by secondary chiller feed
Cooling	FWU	Fan Wall DM	Carrier	DM01	14	Critical	N+2	400/3/50	34	OFCI; 540 kW
Cooling	FWU	Fan Wall DM	Carrier	DM02	14	Critical	N+2	400/3/50	34	OFCI; 540 kW
Cooling	CRAH	CRAH critical powerblock LV1 and 1R LV1 EP	Vertiv	EP LV1 containers (1A, 1B, 1C, R1, 2A, 2B, 2C)	14	Critical	N+1	400/3/50	8	OFCI; 105 kW unit, 2 for each pod
Cooling	CRAH	CRAH critical powerblock LV2 EP	Vertiv	EP LV2 containers (1A, 1B, 1C, 2A, 2B, 2C)	12	Critical	N+1	400/3/50	2,1	OFCI: 50 kW unit, 2 for each pod
Cooling	CRAH	CRAH 1H LV1 and 1R LV2 EP	Vertiv	EP containers (R1, H1)	2	Critical	N+1	400/3/50	1	OFCI: 25 kW unit, 2 for each pod
Cooling	CRAH	CRAH CER	Vertiv	CER01	2	Critical	N+1	400/3/50	1	40 kW unit
Cooling	CRAH	CRAH CER	Vertiv	CER02	2	Critical	N+1	400/3/50	1	40 kW unit
Cooling	DXI / DXC	DX split system Battery	TBD	Battery	16	Critical	N+1	230/1/50	2,6	OFCI; 10 kW unit, 2 for each battery
Cooling	DXI / DXC	DX split system EG	Daikin	EG01	4	Critical	N+1	400/3/50	2,6	10 kW unit, ceiling unit
Cooling	DXI / DXC	DX split system EG	Daikin	EG02	4	Critical	N+1	400/3/50	2,6	10 kW unit, ceiling unit
Cooling	DXI / DXC	DX split system MMR	Daikin	MMR01	2	Critical	N+1	400/3/50	2,6	10 kW unit, wall unit
Cooling	DXI / DXC	DX split system MMR	Daikin	MMR02	2	Critical	N+1	400/3/50	2,6	10 kW unit, wall unit
Cooling	VDP	Pressurization/Degassing system	IMI	Roof mech container	3	Critical	N+1	230/1/50	1,5	
Cooling	SSF	Side stream filtration	FAM	Roof mech container	2	Critical	N	400/3/50	4	
Cooling/Heating	VRFC	VRF outdoor unit	Daikin	Office Roof (ground floor)	2	Non-critical	-	400/3/50	28	MCA = 43.6 Kw
Cooling/Heating	VRFC	VRF outdoor unit	Daikin	Office Roof (first floor)	2	Non-critical	-	400/3/50	25	MCA = 41.1 Kw
Heating	ELH	Electric heater	TBD	SPK01, SPK02	2	Non-critical	-	230/1/50	1	
Heating	ELH	Electric heater	TBD	WAT01, FCR01 ,SPH02, CHG11, CHG12	5	Non-critical	-	230/1/50	0,75	
Cooling/Heating	DXI / DXC	DX split system fire pump	Daikin	Campus fire pump room	1	Non-critical	-	400/3/50	2,6	10 kW unit
Cooling/Heating	DXI / DXC	DX split system mechanical container	Daikin	Mechanical pump room	2	Non-critical	-	400/3/50	1,5	10 kW unit
Cooling/Heating	VRFD	VRF Ducted Fan Coil Unit	Daikin	Offices	26	Non-critical	-	230/1/50	0,5	
Cooling/Heating	VRFA	VRF Air Curtain	Daikin	LOB01	1	Non-critical	-	230/1/50	1,2	
Cooling/Heating	VRFC	VRF Cassetta 4 way	Daikin	Offices	3	Non-critical	-	230/1/50	0,1	
Ventilation	AIR	Electrical Air Curtain	TBD	Loading	2	Non-critical	-	230/1/50	2,5	
Ventilation	AHU	DM DOAS	Roccheggiani	Critical Roof	2	Critical	N+1	400/3/50	40	
Ventilation	AHU	ADM DOAS	Roccheggiani	Office Roof	1	Non-critical	-	400/3/50	60	
Ventilation	TEF	Toilet extraction fan	TBD	Office Roof	1	Non-critical	-	230/1/50	0,5	
Ventilation	BEF	Battery extraction fan	TBD	Office Roof	16	Critical	N+1	230/1/50	0,5	OFCI; 2 for each battery
Ventilation	SEF	Smoke extraction fan DM	Systemair	Critical Roof	2	Non-critical	-	400/3/50	11	
Ventilation	SSF	Fresh air supply fan DM	Systemair	Critical Roof	2	Non-critical	-	400/3/50	11	
Plumbing	HPH	Hot tap water heat pump	Aermec	Water Entry	1	Non-critical	-	230/1/50	1,5	
Plumbing	PHW	Hot tap water recirculation pump	Grundfos	Water Entry	1	Non-critical	-	230/1/50	0,1	
Plumbing	PTW	Tap water pressurization pump	DAB	Water Entry	1	Non-critical	-	400/3/50	5,5	
Fire suppression	NGE	Nitrogen generator	Potter	SPK01	1	Non-critical	-	400/3/50	5	
Fire suppression	NGE	Nitrogen generator	Potter	SPK02	1	Non-critical	-	400/3/50	5	
Plumbing	FRP	First rainwater	DAB	Campus	2	Non-critical	N+1	400/3/50	2,2	
Plumbing	BSP	Wastewater pump	DAB	Campus	2	Non-critical	N+1	400/3/50	1,5	
Plumbing	RWP	Rainwater pump	DAB	Campus	4	Non-critical	N+1	400/3/50	7,5	

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-ZZ-XX-CA-M-50003

13038001

Title:

Calculation
Heat Loads
Non Critical Spaces

PD0 - RIBA 3	**ITM**	**50003**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Heat Loads - Non Critical Spaces
Document ID	MIL07-DBA-ZZ-XX-CA-M-50003
Date	7-11-2025
Revision	P01

CALCULATION INPUT DATA SUMMARY

Weather Data (ASHRAE 2025 Linate station):
Winter: -4,0°C / -6,0°C (DB/WB)
Summer: 33,8°C / 26,0°C (DB/WB)

Building energy characteristics:
External walls thermal transmittance: 0,168 W/m2K
Roof thermal transmittance: 0,149 W/m2K
Windows thermal transmittance: 1,300 W/m2K
Windows g value: 0,350
External doors thermal transmittance: 0,500 W/m2K
Slab floor on grade thermal transmittance: 0,171 W/m2K
Internal partitions thermal transmittance: 0,706 W/m2K
Unconditioned spaces max temperature: 30 °C
Natural ventilation losses: 0,3 Vol/h considered just for rooms with windows or external doors

Internal loads:
Lighting: 10 W/m2
People offices: 71,8 W/person sensible, 60,1 W/person latent (Office work)
People storages: 86,5 W/person sensible, 133,3 W/person latent (Medium work)
Occupancy: see MIL07-DBA-ZZ-XX-CA-M-50001
Electrical equipments offices: 200 W each PC (1 per person) + 1000 W each office (printer, scanner…etc)

Thermal zones (see zoning drawings for more detail):
Heating/cooling with VRF system: Offices, conference rooms, break rooms, lobby and big storages, loading and staging
Heating with electric radiators (20 °C): small storages and bathrooms
Heating with electric radiators (10 °C): technical rooms

DATI PROGETTO ED IMPOSTAZIONI DI CALCOLO

Dati generali

Destinazione d'uso prevalente (DPR 412/93)	***E.2 Edifici adibiti a uffici e assimilabili.***
Edificio pubblico o ad uso pubblico	***No***
Edificio situato in un centro storico	***No***
Tipologia di calcolo	***Calcolo regolamentare (valutazione A1/A2)***

Opzioni lavoro

Ponti termici	***Calcolo analitico***
Resistenze liminari	***Appendice A UNI EN ISO 6946***
Serre / locali non climatizzati	***Calcolo analitico***
Capacità termica	***Calcolo semplificato***
Ombreggiamenti	***Calcolo manuale***
Radiazione solare	***Calcolo con angolo di Azimut***

Opzioni di calcolo

Regime normativo	***UNI/TS 11300-4 e 5:2016***
Rendimento globale medio stagionale	***FAQ ministeriali (agosto 2016)***
Verifica di condensa interstiziale	***UNI EN ISO 13788***

DATI CLIMATICI DELLA LOCALITÀ

Caratteristiche geografiche

Località		***Siziano***		
Provincia		***Pavia***		
Altitudine s.l.m.			***93***	m
Latitudine nord	***45° 18'***	Longitudine est	***9° 12'***	
Gradi giorno DPR 412/93			***2601***	
Zona climatica			***E***	

Località di riferimento

per dati invernali	***Pavia***
per dati estivi	***Pavia***

Stazioni di rilevazione

per la temperatura	***S.Angelo Lodigiano***
per l'irradiazione	***S.Angelo Lodigiano***
per il vento	***S.Angelo Lodigiano***

Caratteristiche del vento

Regione di vento:	***A***	
Direzione prevalente	***Sud-Ovest***	
Distanza dal mare	***> 40***	km
Velocità media del vento	***0,7***	m/s
Velocità massima del vento	***1,4***	m/s

Dati invernali

Temperatura esterna di progetto	***-5,1***	°C
Stagione di riscaldamento convenzionale	dal ***15 ottobre*** al ***15 aprile***	

Dati estivi

Temperatura esterna bulbo asciutto	***32,0***	°C
Temperatura esterna bulbo umido	***23,6***	°C
Umidità relativa	***50,0***	%
Escursione termica giornaliera	***12***	°C

Temperature esterne medie mensili

Descrizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Temperatura	°C	*1,4*	*4,5*	*9,4*	*12,6*	*18,4*	*22,4*	*24,1*	*22,6*	*17,8*	*14,1*	*6,4*	*1,5*

Irradiazione solare media mensile

Esposizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Nord	MJ/m²	*1,6*	*2,4*	*3,7*	*5,3*	*8,4*	*10,2*	*9,7*	*6,8*	*4,5*	*2,8*	*1,8*	*1,3*
Nord-Est	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Est	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Sud-Est	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Sud	MJ/m²	*10,1*	*11,2*	*13,4*	*10,6*	*10,5*	*10,6*	*11,1*	*11,3*	*12,6*	*8,7*	*10,7*	*7,6*
Sud-Ovest	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Ovest	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Nord-Ovest	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Orizz. Diffusa	MJ/m²	*2,1*	*3,2*	*4,7*	*6,6*	*9,5*	*9,6*	*9,0*	*7,5*	*5,7*	*4,1*	*2,5*	*1,9*
Orizz. Diretta	MJ/m²	*2,9*	*4,6*	*8,6*	*9,5*	*11,1*	*14,1*	*15,1*	*12,2*	*9,8*	*3,8*	*3,5*	*1,9*

Irradianza sul piano orizzontale nel mese di massima insolazione: ***279*** W/m²

FABBISOGNO DI POTENZA TERMICA INVERNALE secondo UNI EN 12831

Dati climatici della località:

Località	***Siziano***	
Provincia	***Pavia***	
Altitudine s.l.m.	***93***	m
Gradi giorno	***2601***	
Zona climatica	***E***	
Temperatura esterna di progetto	***-5,1***	°C

Dati geometrici dell'intero edificio:

Superficie in pianta netta	***5754,34***	m^2
Superficie esterna lorda	***15149,10***	m^2
Volume netto	***26288,30***	m^3
Volume lordo	***36519,00***	m^3
Rapporto S/V	***0,41***	m^{-1}

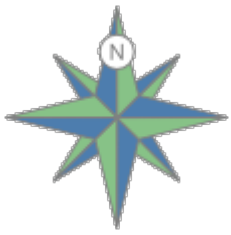
Opzioni di calcolo:

Metodologia di calcolo	***Vicini presenti***	
Coefficiente di sicurezza adottato	***1,00***	-

Coefficienti di esposizione solare:

Nord: ***1,20***

Nord-Ovest: ***1,15***



Nord-Est: ***1,20***

Ovest: ***1,10***

Est: ***1,15***

Sud-Ovest: ***1,05***

Sud-Est: ***1,10***

Sud: ***1,00***

DISPERSIONI DEI COMPONENTI

Zona 1 - Zona uffici

Dettaglio delle dispersioni per trasmissione dei componenti

Dispersioni strutture opache:

Cod	Tipo	Descrizione elemento	U [W/m²K]	θe [°C]	S_{Tot} [m²]	Φ_{tr} [W]	% Φ_{Tot} [%]
M1	T	CV1 - Parete vs esterno (con cls)	0,170	-5,1	257,31	1150	3,8
M2	T	CV2 - Parete vs esterno (con cls - locali tecnici)	0,170	-5,1	93,18	286	0,9
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	555,38	1701	5,6
M13	U	CV13 - vs locale tecnico (cls espanso)	0,706	10,0	52,88	224	0,7
M14	U	CV14 - Da tecnico a corridoio (cls espanso - amalitico)	0,706	20,0	91,59	1	0,0
M21	U	CV21 - vs non riscaldato (cls espanso - analitico)	0,706	20,0	54,95	1	0,0
M22	U	CV22 - Da locale critico a tecnico (cls espanso)	0,706	10,0	0,04	0	0,0
M26	U	CV26 - Da locale DX a tecnico (cls espanso)	0,706	10,0	0,04	0	0,0
M31	A	CV31 - vs DX	0,706	25,0	216,05	-762	-2,5
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	239,29	4814	15,9
M42	U	CV42: vs non climatizzato (vs scala con controparete - 1 parete esterna)	0,354	10,0	20,38	73	0,2
M43	U	CV43: vs non climatizzato (vs scala con controparete - 1 parete esterna)	0,354	10,0	13,60	48	0,2
M45	U	CV45: vs non climatizzato (vs scala - analitico)	2,004	20,0	31,96	1	0,0
M66	U	CV66 - Porta locali tecnico vs non climatizzato COR02 (analitico)	0,489	20,0	2,16	0	0,0
M73	A	CV73 - Porta vs locale DX	0,489	25,0	16,20	-40	-0,1
M82	T	CV82 - Porta corridoio p1 vs esterno	0,511	-5,1	2,16	30	0,1
M83	T	CV83 - Porta da locale tecnico vs esterno	0,511	-5,1	4,32	40	0,1
M84	T	CV84 - Vs esterno	0,511	-5,1	4,32	60	0,2
M85	T	CV85 - Vs esterno (portone lobby)	0,910	-5,1	25,80	589	1,9
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	283,23	1218	4,0
P2	G	PV2: vs terreno	0,233	-5,1	406,27	2376	7,9
P7	G	PV7: vs terreno da locale tecnico	0,276	-5,1	68,46	334	1,1
P8	G	PV8: vs terreno da Loading	0,269	-5,1	135,95	919	3,0
P11	A	PV-11: vs DX	0,896	25,0	90,20	-404	-1,3
P12	A	PV-12: vs locale critico	0,896	27,0	40,11	-252	-0,8
P13	U	PV-13: vs locale tecnico	0,896	10,0	55,82	500	1,7
S1	T	CO1 - Verso esterno	0,148	-5,1	1021,67	3796	12,5
S5	T	CO5 - Verso esterno da locale tecnico	0,148	-5,1	17,92	67	0,2

Totale: **16772** **55,4**

Dispersioni strutture trasparenti:

Cod	Tipo	Descrizione elemento	U [W/m²K]	θe [°C]	S_{Tot} [m²]	Φ_{tr} [W]	% Φ_{Tot} [%]
W1	T	F1 : 15x2M	1,342	-5,1	30,20	1221	4,0
W2	T	F2 : 16.6 x 4M	1,365	-5,1	119,17	4491	14,8
W3	T	F3 : 9.3 X 4 M	1,331	-5,1	33,77	1298	4,3
W4	T	F4 : 29.3 X 4 M	1,361	-5,1	104,92	4123	13,6

Totale: **11134** **36,8**

Dispersioni dei ponti termici:

Cod	Tipo	Descrizione elemento	Ψ [W/mK]	L_{Tot} [m]	Φ_{tr} [W]	% Φ_{Tot} [%]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	364,84	1	0,0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	128,91	456	1,5
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	128,92	1057	3,5
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	25,34	142	0,5
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	73,48	642	2,1
Z31	-	PT1 - Parete con controparete - Telaio	0,034	55,32	56	0,2

Totale: **2353** **7,8**

Zona 2 - Zona critica

Dettaglio delle dispersioni per trasmissione dei componenti

Dispersioni strutture opache:

Cod	Tipo	Descrizione elemento	U [W/m²K]	θe [°C]	S_{Tot} [m²]	Φ_{tr} [W]	% Φ_{Tot} [%]
M3	T	CV3 - Parete vs esterno (con cls - locali DX)	0,170	-5,1	52,94	306	0,6
M4	T	CV4 - Parete vs esterno (con cls - mechanical gallery) (?)	0,170	-5,1	959,44	6268	12,4
M9	T	CV9 - Parete vs esterno (con cls - locale critico)	0,170	-5,1	68,92	375	0,7
M11	U	CV11 - Da locale critico a corridio COR03(cls espanso - analitico)	0,706	20,0	528,76	9	0,0
M17	U	CV17 - Da DX a corridio COR02 (cls espanso - analitico)	0,706	20,0	119,67	2	0,0
M19	U	CV19 - Da Mechanical Gallery a corridio COR02 (cls espanso - analitico)	0,706	20,0	88,67	1	0,0
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	402,63	3647	7,2
M22	U	CV22 - Da locale critico a tecnico (cls espanso)	0,706	10,0	27,13	245	0,5
M23	U	CV23 - Da DX a cavedio (cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	49,66	422	0,8

M26	U	CV26 - Da locale DX a tecnico (cls espanso)	0,706	10,0	36,24	307	0,6
M31	A	CV31 - vs DX	0,706	25,0	34,81	49	0,1
M32	A	CV32 - Da locale critico a DX (cls espanso)	0,706	25,0	104,09	147	0,3
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	750,47	11	0,0
M35	U	CV35 - Da DX a corridio COR03 (cls espanso - analitico)	0,706	20,0	50,82	1	0,0
M36	U	CV36 - Da Mechanical Gallery a corridio COR03 (cls espanso - analitico)	0,706	20,0	25,44	0	0,0
M61	U	CV61 - Porta mechanical gallery vs corridoio COR02 (analitico)	0,489	20,0	6,48	0	0,0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	19,98	0	0,0
M68	U	CV68 - Porta locale DX vs locali corridoio (analitico)	0,489	20,0	14,04	0	0,0
M74	U	CV74 - Porta locali critici vs corridoio COR03(analitico)	0,489	20,0	9,00	0	0,0
M75	U	CV75 - Porta locale DX vs locali corridoio COR03 (analitico)	0,489	20,0	2,16	0	0,0
M76	U	CV76 - Porta mechanical gallery vs corridoio COR03 (analitico)	0,489	20,0	2,16	0	0,0
M86	T	CV86 - Porta locale locale critico vs esterno	0,511	-5,1	2,16	35	0,1
P3	G	PV3: vs terreno da locale dx	0,436	-5,1	120,17	1578	3,1
P4	G	PV4: vs terreno da locale critico	0,012	-5,1	3312,06	1235	2,4
P5	G	PV5: vs terreno da locale critico ritorno crah	0,303	-5,1	727,59	7074	14,0
S2	T	CO2 - Verso esterno da DM	0,148	-5,1	3997,08	18992	37,7
S4	T	CO4 - Verso esterno da DX	0,148	-5,1	36,40	162	0,3
S6	A	SF-01: da DX vs ufficio	1,606	20,0	83,77	673	1,3
S10	A	SF-01: da locale critico vs ufficio	1,606	20,0	42,07	473	0,9
					Totale:	**42014**	**83,3**

Dispersioni dei ponti termici:

Cod	Tipo	Descrizione elemento	Ψ [W/mK]	L_{Tot} [m]	Φ_{tr} [W]	% Φ_{Tot} [%]
Z2	-	PC2 - Parete blocchetti (mechanical gallery) - Copertura	-0,032	165,01	-171	-0,3
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	391,64	1	0,0
Z13	-	PI3 - Parete blocchetti - Solaio interpiano (locale DX)	0,000	9,27	0	0,0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	377,88	353	0,7
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	414,70	4443	8,8
Z25	-	GF25 - Parete (locale DX) - Solaio controterra	0,338	2,28	23	0,0
Z26	-	GF26 - Parete (DM) - Solaio controterra	0,338	316,38	3773	7,5

Totale:	***8422***	***16,7***

Legenda simboli

U	Trasmittanza termica dell'elemento disperdente
Ψ	Trasmittanza termica lineica del ponte termico
θe	Temperatura di esposizione dell'elemento
S_{Tot}	Superficie totale su tutto l'edificio dell'elemento disperdente
L_{Tot}	Lunghezza totale su tutto l'edificio del ponte termico
Φ_{tr}	Potenza dispersa per trasmissione
$\%\Phi_{Tot}$	Rapporto percentuale tra il Φ_{tr} dell'elemento e il Φ_{tr} totale dell'edificio

POTENZE DI PROGETTO DEI LOCALI

Opzioni di calcolo:

Metodologia di calcolo	***Vicini presenti***	
Coefficiente di sicurezza adottato	***1,00***	-

Zona 1 - Zona uffici

Dettaglio del fabbisogno di potenza dei locali

Zona: ***1*** **Locale:** ***1*** **Descrizione:** ***RES03 - Men's toilet***

Superficie in pianta netta	***14,23***	m^2	Volume netto	***42,69***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***3,51***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P2	*G*	*PV2: vs terreno*	*0,233*	*-5,1*	*OR*	*1,00*	*16,30*	*95*

Dispersioni per trasmissione:	Φ_{tr}=	***95***
Dispersioni per ventilazione:	Φ_{ve}=	***389***
Dispersioni per intermittenza:	Φ_{rh}=	***228***
Dispersioni totali:	Φ_{hl}=	***712***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***712***

Zona: ***1*** **Locale:** ***2*** **Descrizione:** ***SOC01 - SOC storage***

Superficie in pianta netta	***11,85***	m^2	Volume netto	***75,25***	m^3
Altezza netta	***6,35***	m	Ricambio d'aria	***0,66***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*N*	*1,20*	*3,48*	*35*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*23,69*	*78*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*E*	*1,15*	*4,59*	*44*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*E*	*1,15*	*31,20*	*98*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*8,07*	*68*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*15,98*	*69*

Dispersioni per trasmissione:	Φ_{tr}=	***392***
Dispersioni per ventilazione:	Φ_{ve}=	***130***
Dispersioni per intermittenza:	Φ_{rh}=	***190***
Dispersioni totali:	Φ_{hl}=	***711***

Dispersioni totali con coefficiente di sicurezza: $\Phi_{hl\ sic}$= ***711***

Zona: ***1*** **Locale:** ***3*** **Descrizione:** ***SOC02 - Security operation center***

Superficie in pianta netta	***40,18***	m^2	Volume netto	***120,54***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***0,66***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*N*	*1,20*	*10,10*	*101*
Z31	*-*	*PT1 - Parete con controparete - Telaio*	*0,034*	*-5,1*	*N*	*1,20*	*21,14*	*22*
W1	*T*	*F1 : 15x2M*	*1,342*	*-5,1*	*N*	*1,20*	*19,14*	*774*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*15,71*	*52*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*10,10*	*86*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*46,31*	*199*

Dispersioni per trasmissione:	Φ_{tr}=	***1233***
Dispersioni per ventilazione:	Φ_{ve}=	***207***
Dispersioni per intermittenza:	Φ_{rh}=	***643***
Dispersioni totali:	Φ_{hl}=	***2083***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***2083***

Zona: ***1*** **Locale:** ***4*** **Descrizione:** ***SOC03 - SOC Manager Office***

Superficie in pianta netta	***12,24***	m^2	Volume netto	***36,72***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***1,36***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*N*	*1,20*	*3,19*	*32*
Z31	*-*	*PT1 - Parete con controparete - Telaio*	*0,034*	*-5,1*	*N*	*1,20*	*6,39*	*7*
W1	*T*	*F1 : 15x2M*	*1,342*	*-5,1*	*N*	*1,20*	*6,39*	*258*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*4,63*	*15*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*3,19*	*27*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*14,61*	*63*

Dispersioni per trasmissione:	Φ_{tr}=	***402***
Dispersioni per ventilazione:	Φ_{ve}=	***130***
Dispersioni per intermittenza:	Φ_{rh}=	***196***
Dispersioni totali:	Φ_{hl}=	***727***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***727***

Zona: ***1*** **Locale:** ***5*** **Descrizione:** ***BRK02 - Break Room***

Superficie in pianta netta	***30,58***	m^2	Volume netto	***91,74***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***2,40***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*N*	*1,20*	*5,43*	*54*
Z31	*-*	*PT1 - Parete con controparete - Telaio*	*0,034*	*-5,1*	*N*	*1,20*	*6,67*	*7*
W1	*T*	*F1 : 15x2M*	*1,342*	*-5,1*	*N*	*1,20*	*4,67*	*189*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*14,07*	*46*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*5,43*	*46*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*34,02*	*146*

Dispersioni per trasmissione:	Φ_{tr}=	***489***
Dispersioni per ventilazione:	Φ_{ve}=	***571***
Dispersioni per intermittenza:	Φ_{rh}=	***489***
Dispersioni totali:	Φ_{hl}=	***1548***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***1548***

Zona: ***1*** **Locale:** ***6*** **Descrizione:** ***LOB01 - Lobby***

Superficie in pianta netta	***48,52***	m^2	Volume netto	***145,56***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***0,69***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*-5,1*	*E*	*1,15*	*4,93*	*47*
Z31	*-*	*PT1 - Parete con controparete - Telaio*	*0,034*	*-5,1*	*E*	*1,15*	*8,08*	*8*
W3	*T*	*F3 : 9.3 X 4 M*	*1,331*	*-5,1*	*E*	*1,15*	*15,69*	*603*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*E*	*1,15*	*1,30*	*4*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*4,93*	*42*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*52,56*	*226*

Dispersioni per trasmissione:	Φ_{tr}=	***930***
Dispersioni per ventilazione:	Φ_{ve}=	***259***
Dispersioni per intermittenza:	Φ_{rh}=	***776***
Dispersioni totali:	Φ_{hl}=	***1966***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***1966***

Zona: ***1*** **Locale:** ***7*** **Descrizione:** ***CON01 - Conference Room***

Superficie in pianta netta	***47,01***	m^2	Volume netto	***298,52***	m^3
Altezza netta	***6,35***	m	Ricambio d'aria	***0,60***	1/h

Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	-5,1	E	1,15	9,20	88
Z31	-	PT1 - Parete con controparete - Telaio	0,034	-5,1	E	1,15	13,04	13
W3	T	F3 : 9.3 X 4 M	1,331	-5,1	E	1,15	18,08	695
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	E	1,15	44,51	140
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	9,20	78
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	52,88	227

Dispersioni per trasmissione:	Φ_{tr}=	**1241**
Dispersioni per ventilazione:	Φ_{ve}=	**467**
Dispersioni per intermittenza:	Φ_{rh}=	**752**
Dispersioni totali:	Φ_{hl}=	**2460**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**2460**

Zona: **1** **Locale:** **8** **Descrizione:** **CON02 - Magazzino sala conferenze**

Superficie in pianta netta	**2,38**	m²	Volume netto	**15,11**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**3,31**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	2,84	12

Dispersioni per trasmissione:	Φ_{tr}=	**12**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**38**
Dispersioni totali:	Φ_{hl}=	**180**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**180**

Zona: **1** **Locale:** **9** **Descrizione:** **SHP01 - Loading-unloading area**

Superficie in pianta netta	**122,94**	m²	Volume netto	**780,67**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**0,41**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	0,30	1
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	2,41	48
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	E	1,15	11,14	109

M84	T	CV84 - Vs esterno	0,511	-5,1	E	1,15	2,16	32
M1	T	CV1 - Parete vs esterno (con cls)	0,170	-5,1	E	1,15	85,73	420
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	S	1,00	13,59	116
M85	T	CV85 - Vs esterno (portone lobby)	0,910	-5,1	S	1,00	12,90	295
M85	T	CV85 - Vs esterno (portone lobby)	0,910	-5,1	S	1,00	12,90	295
M84	T	CV84 - Vs esterno	0,511	-5,1	S	1,00	2,16	28
M1	T	CV1 - Parete vs esterno (con cls)	0,170	-5,1	S	1,00	79,30	338
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	0,30	3
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	OR	1,00	24,73	211
P8	G	PV8: vs terreno da Loading	0,269	-5,1	OR	1,00	135,95	919

Dispersioni per trasmissione:	Φ_{tr}=	**2813**
Dispersioni per ventilazione:	Φ_{ve}=	**830**
Dispersioni per intermittenza:	Φ_{rh}=	**1967**
Dispersioni totali:	Φ_{hl}=	**5610**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**5610**

Zona: **1** **Locale:** **10** **Descrizione:** **OFF01 - Asset managment office**

Superficie in pianta netta	**9,83**	m^2	Volume netto	**29,49**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**1,70**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	4,38	15
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	19,00	382
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	4,38	37
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	12,00	70

Dispersioni per trasmissione:	Φ_{tr}=	**504**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**157**
Dispersioni totali:	Φ_{hl}=	**791**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**791**

Zona: **1** **Locale:** **11** **Descrizione:** **EVR02 - Freight elevator**

Superficie in pianta netta	**15,29**	m^2	Volume netto	**97,09**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,50**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]

Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,70	0
M45	U	CV45: vs non climatizzato (vs scala - analitico)	2,004	20,0	-	0,00	31,96	1
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	4,70	40
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	18,62	80

Dispersioni per trasmissione:	Φ_{tr}=	**121**
Dispersioni per ventilazione:	Φ_{ve}=	**126**
Dispersioni per intermittenza:	Φ_{rh}=	**245**
Dispersioni totali:	Φ_{hl}=	**492**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**492**

Zona: **1** **Locale:** **12** **Descrizione:** **STG01 - Staging-Receiving Area**

Superficie in pianta netta	**64,57**	m^2	Volume netto	**410,02**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,44**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	0,20	1
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	1,54	31
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	S	1,00	6,00	51
M1	T	CV1 - Parete vs esterno (con cls)	0,170	-5,1	S	1,00	46,10	196
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	0,20	2
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	OR	1,00	6,00	51
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	69,79	408

Dispersioni per trasmissione:	Φ_{tr}=	**740**
Dispersioni per ventilazione:	Φ_{ve}=	**467**
Dispersioni per intermittenza:	Φ_{rh}=	**1033**
Dispersioni totali:	Φ_{hl}=	**2240**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**2240**

Zona: **1** **Locale:** **13** **Descrizione:** **SHF02 - Shaft**

Superficie in pianta netta	**5,66**	m^2	Volume netto	**35,94**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**1,39**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con	0,332	20,0	-	0,00	1,75	0

		vespaio						
M21	U	CV21 - vs non riscaldato (cls espanso - analitico)	0,706	20,0	-	0,00	13,46	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	1,75	15
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	6,86	40

Dispersioni per trasmissione:	Φ_{tr}=	**55**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**91**
Dispersioni totali:	Φ_{hl}=	**275**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**275**

Zona: **1** **Locale:** **14** **Descrizione:** **STO02- Storage**

Superficie in pianta netta	**62,23**	m^2	Volume netto	**395,16**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,51**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	S	1,00	6,01	51
M1	T	CV1 - Parete vs esterno (con cls)	0,170	-5,1	S	1,00	46,18	197
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	11,15	-19
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	85,72	-302
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	11,15	95
Z28	-	GF28 - Parete (loading) - Solaio controterra	0,340	-5,1	OR	1,00	6,01	51
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	66,94	391

Dispersioni per trasmissione:	Φ_{tr}=	**464**
Dispersioni per ventilazione:	Φ_{ve}=	**519**
Dispersioni per intermittenza:	Φ_{rh}=	**996**
Dispersioni totali:	Φ_{hl}=	**1979**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1979**

Zona: **1** **Locale:** **15** **Descrizione:** **VST01 - Disimpegno**

Superficie in pianta netta	**3,66**	m^2	Volume netto	**10,98**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**4,55**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	4,27	18

Dispersioni per trasmissione:	Φ_{tr}=	**18**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**59**
Dispersioni totali:	Φ_{hl}=	**207**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**207**

Zona: ***1*** **Locale:** ***16*** **Descrizione:** ***VST02 - Disimpegno***

Superficie in pianta netta	***2,58***	m^2	Volume netto	***7,74***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***6,46***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*3,06*	*13*

Dispersioni per trasmissione:	Φ_{tr}=	***13***
Dispersioni per ventilazione:	Φ_{ve}=	***130***
Dispersioni per intermittenza:	Φ_{rh}=	***41***
Dispersioni totali:	Φ_{hl}=	***184***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***184***

Zona: ***1*** **Locale:** ***17*** **Descrizione:** ***RES04 - Unisex toilet***

Superficie in pianta netta	***5,12***	m^2	Volume netto	***15,36***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***3,26***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*10,0*	*-*	*0,00*	*2,31*	*8*
M43	*U*	*CV43: vs non climatizzato (vs scala con controparete - 1 parete esterna)*	*0,354*	*10,0*	*-*	*0,00*	*7,96*	*28*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*2,31*	*20*
P1	*G*	*PV1: vs terreno con vespaio*	*0,171*	*-5,1*	*OR*	*1,00*	*7,29*	*31*

Dispersioni per trasmissione:	Φ_{tr}=	***87***
Dispersioni per ventilazione:	Φ_{ve}=	***130***
Dispersioni per intermittenza:	Φ_{rh}=	***82***
Dispersioni totali:	Φ_{hl}=	***299***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***299***

Zona: ***1*** **Locale:** ***18*** **Descrizione:** ***RES05 - Accessible toilet***

Superficie in pianta netta	***3,45***	m^2	Volume netto	***10,35***	m^3
Altezza netta	***3,00***	m	Ricambio d'aria	***4,83***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*10,0*	*-*	*0,00*	*1,63*	*5*
M43	*U*	*CV43: vs non climatizzato (vs scala con controparete - 1 parete esterna)*	*0,354*	*10,0*	*-*	*0,00*	*5,64*	*20*
Z23	*-*	*GF23 - Parete (locale critico)*	*0,338*	*-5,1*	*OR*	*1,00*	*1,63*	*14*

		- Solaio controterra						
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	5,17	22

Dispersioni per trasmissione: Φ_{tr}= **62**
Dispersioni per ventilazione: Φ_{ve}= **130**
Dispersioni per intermittenza: Φ_{rh}= **55**
Dispersioni totali: Φ_{hl}= **246**
Dispersioni totali con coefficiente di sicurezza: $\Phi_{hl\ sic}$= **246**

Zona: **1** **Locale:** **19** **Descrizione:** **JAN01 - Janitorial**

Superficie in pianta netta	**8,88**	m^2	Volume netto	**26,64**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**6,38**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	3,19	11
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	13,86	279
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	2,50	8
M42	U	CV42: vs non climatizzato (vs scala con controparete - 1 parete esterna)	0,354	10,0	-	0,00	10,85	39
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,83	6
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	7,94	160
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	7,53	64
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	12,22	71

Dispersioni per trasmissione: Φ_{tr}= **638**
Dispersioni per ventilazione: Φ_{ve}= **441**
Dispersioni per intermittenza: Φ_{rh}= **142**
Dispersioni totali: Φ_{hl}= **1221**
Dispersioni totali con coefficiente di sicurezza: $\Phi_{hl\ sic}$= **1221**

Zona: **1** **Locale:** **20** **Descrizione:** **RES01 - Accessible toillet**

Superficie in pianta netta	**4,85**	m^2	Volume netto	**14,55**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**3,44**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	6,23	36

Dispersioni per trasmissione: Φ_{tr}= **36**

Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**78**
Dispersioni totali:	Φ_{hl}=	**244**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**244**

Zona: **1** **Locale:** **21** **Descrizione:** **RES02 - Women's toilet**

Superficie in pianta netta	**14,28**	m²	Volume netto	**42,84**	m³
Altezza netta	**3,00**	m	Ricambio d'aria	**3,50**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	16,35	96

Dispersioni per trasmissione:	Φ_{tr}=	**96**
Dispersioni per ventilazione:	Φ_{ve}=	**389**
Dispersioni per intermittenza:	Φ_{rh}=	**228**
Dispersioni totali:	Φ_{hl}=	**713**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**713**

Zona: **1** **Locale:** **22** **Descrizione:** **STO01 - Storage**

Superficie in pianta netta	**41,57**	m²	Volume netto	**263,97**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**0,53**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	43,95	257

Dispersioni per trasmissione:	Φ_{tr}=	**257**
Dispersioni per ventilazione:	Φ_{ve}=	**363**
Dispersioni per intermittenza:	Φ_{rh}=	**665**
Dispersioni totali:	Φ_{hl}=	**1285**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1285**

Zona: **1** **Locale:** **23** **Descrizione:** **SHF01 - Shaft**

Superficie in pianta netta	**7,81**	m²	Volume netto	**49,59**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**1,01**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	3,16	-5
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	24,30	-86
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	3,16	27
P2	G	PV2: vs terreno	0,233	-5,1	OR	1,00	4,15	24

Dispersioni per trasmissione:	Φ_{tr}=	**-40**
Dispersioni per ventilazione:	Φ_{ve}=	**130**

Dispersioni per intermittenza:	Φ_{rh}=	**125**
Dispersioni totali:	Φ_{hl}=	**215**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**215**

Zona: ***1*** **Locale:** ***24*** **Descrizione:** ***COR01 - Corridor***

Superficie in pianta netta	***140,77***	m^2	Volume netto	***893,89***	m^3
Altezza netta	***6,35***	m	Ricambio d'aria	***0,50***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*6,65*	*-11*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*1,98*	*-5*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*5,04*	*-12*
M31	*A*	*CV31 - vs DX*	*0,706*	*25,0*	*-*	*0,00*	*44,08*	*-155*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*10,0*	*-*	*0,00*	*2,55*	*9*
M41	*U*	*CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*	*2,004*	*10,0*	*-*	*0,00*	*19,61*	*395*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*10,0*	*-*	*0,00*	*3,26*	*11*
M41	*U*	*CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*	*2,004*	*10,0*	*-*	*0,00*	*25,03*	*504*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*3,56*	*-6*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*2,16*	*-5*
M31	*A*	*CV31 - vs DX*	*0,706*	*25,0*	*-*	*0,00*	*25,18*	*-89*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*5,69*	*-9*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*5,04*	*-12*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*1,98*	*-5*
M31	*A*	*CV31 - vs DX*	*0,706*	*25,0*	*-*	*0,00*	*36,77*	*-130*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*20,0*	*-*	*0,00*	*2,68*	*0*
M21	*U*	*CV21 - vs non riscaldato (cls espanso - analitico)*	*0,706*	*20,0*	*-*	*0,00*	*20,57*	*0*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*20,0*	*-*	*0,00*	*2,72*	*0*
M21	*U*	*CV21 - vs non riscaldato (cls espanso - analitico)*	*0,706*	*20,0*	*-*	*0,00*	*20,92*	*0*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*27,10*	*230*
P2	*G*	*PV2: vs terreno*	*0,233*	*-5,1*	*OR*	*1,00*	*151,48*	*886*

Dispersioni per trasmissione:	Φ_{tr}=	**1593**
Dispersioni per ventilazione:	Φ_{ve}=	**1159**
Dispersioni per intermittenza:	Φ_{rh}=	**2252**
Dispersioni totali:	Φ_{hl}=	**5005**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**5005**

Zona: **1** **Locale:** **25** **Descrizione:** **SHF01 - Shaft**

Superficie in pianta netta	**8,23**	m^2	Volume netto	**52,26**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,96**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*9,12*	*34*

Dispersioni per trasmissione:	Φ_{tr}=	**34**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**132**
Dispersioni totali:	Φ_{hl}=	**295**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**295**

Zona: **1** **Locale:** **26** **Descrizione:** **SHF02 - Shaft**

Superficie in pianta netta	**5,66**	m^2	Volume netto	**28,30**	m^3
Altezza netta	**5,00**	m	Ricambio d'aria	**1,77**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*O*	*1,10*	*1,75*	*0*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*O*	*1,10*	*10,19*	*31*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*OR*	*1,00*	*1,75*	*0*
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*7,54*	*28*

Dispersioni per trasmissione:	Φ_{tr}=	**59**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**91**
Dispersioni totali:	Φ_{hl}=	**279**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**279**

Zona: **1** **Locale:** **27** **Descrizione:** **EVR02 - Frieght elevator**

Superficie in pianta netta	**15,84**	m^2	Volume netto	**100,58**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,50**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Naturale**		η recuperatore	**-**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*O*	*1,10*	*4,70*	*0*
M7	*T*	*CV7 - Parete vs esterno (con*	*0,109*	*-5,1*	*O*	*1,10*	*33,72*	*101*

		controparete)						
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	4,70	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	19,86	74

Dispersioni per trasmissione:	Φ_{tr}=	**175**
Dispersioni per ventilazione:	Φ_{ve}=	**421**
Dispersioni per intermittenza:	Φ_{rh}=	**253**
Dispersioni totali:	Φ_{hl}=	**849**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**849**

Zona: **1** **Locale:** **28** **Descrizione:** **BRK01 - Break Room**

Superficie in pianta netta	**22,86**	m^2	Volume netto	**145,16**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,69**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	4,90	16
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	33,34	671
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	4,90	42
P1	G	PV1: vs terreno con vespaio	0,171	-5,1	OR	1,00	25,62	110

Dispersioni per trasmissione:	Φ_{tr}=	**839**
Dispersioni per ventilazione:	Φ_{ve}=	**259**
Dispersioni per intermittenza:	Φ_{rh}=	**366**
Dispersioni totali:	Φ_{hl}=	**1464**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1464**

Zona: **1** **Locale:** **29** **Descrizione:** **STR02 - Safe waiting area**

Superficie in pianta netta	**2,34**	m^2	Volume netto	**11,93**	m^3
Altezza netta	**5,10**	m	Ricambio d'aria	**0,50**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	1,38	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	8,15	164
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	20,0	-	0,00	2,07	0
M18	U	CV18 - vs non riscaldato (cls espanso - No pareti esterne)	0,706	20,0	-	0,00	12,29	0
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	3,45	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	3,33	12

Dispersioni per trasmissione:	Φ_{tr}=	**176**
Dispersioni per ventilazione:	Φ_{ve}=	**15**

Dispersioni per intermittenza:	Φ_{rh}=	***37***
Dispersioni totali:	Φ_{hl}=	***229***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***229***

Zona: ***1*** **Locale:** ***30*** **Descrizione:** ***COR11 - Corridor***

Superficie in pianta netta	***124,28***	m^2	Volume netto	***789,18***	m^3
Altezza netta	***6,35***	m	Ricambio d'aria	***0,50***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*O*	*1,10*	*2,73*	*0*
M82	*T*	*CV82 - Porta corridoio p1 vs esterno*	*0,511*	*-5,1*	*O*	*1,10*	*2,16*	*30*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*O*	*1,10*	*36,59*	*110*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*10,0*	*-*	*0,00*	*2,53*	*0*
M41	*U*	*CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*	*2,004*	*10,0*	*-*	*0,00*	*18,12*	*365*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*10,0*	*-*	*0,00*	*3,25*	*0*
M41	*U*	*CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*	*2,004*	*10,0*	*-*	*0,00*	*23,31*	*469*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*OR*	*1,00*	*11,17*	*0*
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*136,03*	*505*

Dispersioni per trasmissione:	Φ_{tr}=	***1479***
Dispersioni per ventilazione:	Φ_{ve}=	***1023***
Dispersioni per intermittenza:	Φ_{rh}=	***1988***
Dispersioni totali:	Φ_{hl}=	***4491***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***4491***

Zona: ***1*** **Locale:** ***31*** **Descrizione:** ***SPK02 - Sprinkler room***

Superficie in pianta netta	***16,07***	m^2	Volume netto	***99,63***	m^3
Altezza netta	***6,20***	m	Ricambio d'aria	***0,50***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
M26	*U*	*CV26 - Da locale DX a tecnico (cls espanso)*	*0,706*	*10,0*	*-*	*0,00*	*0,04*	*0*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*20,0*	*-*	*0,00*	*4,32*	*0*
M66	*U*	*CV66 - Porta locali tecnico vs non climatizzato COR02 (analitico)*	*0,489*	*20,0*	*-*	*0,00*	*2,16*	*0*
M14	*U*	*CV14 - Da tecnico a corridoio (cls espanso - amalitico)*	*0,706*	*20,0*	*-*	*0,00*	*31,84*	*0*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con*	*0,332*	*20,0*	*-*	*0,00*	*4,00*	*0*

		vespaio						
M14	U	CV14 - Da tecnico a corridoio (cls espanso - amalitico)	0,706	20,0	-	0,00	31,46	0
M22	U	CV22 - Da locale critico a tecnico (cls espanso)	0,706	10,0	-	0,00	0,04	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	8,33	71
P7	G	PV7: vs terreno da locale tecnico	0,276	-5,1	OR	1,00	17,92	124
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	8,33	0
S5	T	CO5 - Verso esterno da locale tecnico	0,148	-5,1	OR	1,00	17,92	67

Dispersioni per trasmissione:	Φ_{tr}=	**263**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**257**
Dispersioni totali:	Φ_{hl}=	**649**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**649**

Zona: **1** **Locale:** **36** **Descrizione:** **STO12 - Storage**

Superficie in pianta netta	**48,89**	m^2	Volume netto	**244,45**	m^3
Altezza netta	**5,00**	m	Ricambio d'aria	**0,53**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	N	1,20	9,71	0
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	N	1,20	60,33	198
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	O	1,10	3,48	0
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	O	1,10	3,39	0
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	O	1,10	41,57	125
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	OR	1,00	13,19	0
P13	U	PV-13: vs locale tecnico	0,896	10,0	OR	1,00	33,97	304
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	25,0	OR	1,00	3,39	0
P11	A	PV-11: vs DX	0,896	25,0	OR	1,00	23,55	-106
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	16,57	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	57,52	214

Dispersioni per trasmissione:	Φ_{tr}=	**736**
Dispersioni per ventilazione:	Φ_{ve}=	**337**
Dispersioni per intermittenza:	Φ_{rh}=	**782**
Dispersioni totali:	Φ_{hl}=	**1855**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1855**

Zona: **1** **Locale:** **37** **Descrizione:** **STO11 - Storage**

Superficie in pianta netta	**53,78**	m^2	Volume netto	**268,90**	m^3
Altezza netta	**5,00**	m	Ricambio d'aria	**0,52**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2

Ventilazione ***Meccanica*** η recuperatore ***0,69*** -

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*N*	*1,20*	*5,47*	*0*
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*N*	*1,20*	*3,19*	*0*
W2	*T*	*F2 : 16.6 x 4M*	*1,365*	*-5,1*	*N*	*1,20*	*1,20*	*49*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*50,46*	*166*
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*10,0*	*OR*	*1,00*	*3,19*	*0*
P13	*U*	*PV-13: vs locale tecnico*	*0,896*	*10,0*	*OR*	*1,00*	*21,85*	*196*
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*OR*	*1,00*	*8,66*	*0*
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*59,39*	*221*

Dispersioni per trasmissione: Φ_{tr}= ***631***
Dispersioni per ventilazione: Φ_{ve}= ***363***
Dispersioni per intermittenza: Φ_{rh}= ***860***
Dispersioni totali: Φ_{hl}= ***1855***
Dispersioni totali con coefficiente di sicurezza: $\Phi_{hl\ sic}$= ***1855***

Zona: ***1*** **Locale:** ***38*** **Descrizione:** ***OFF13 - Office***

Superficie in pianta netta ***103,35*** m² Volume netto ***310,05*** m³
Altezza netta ***3,00*** m Ricambio d'aria ***0,55*** 1/h
Temperatura interna ***20,0*** °C Fattore di ripresa ***16*** W/m²
Ventilazione ***Meccanica*** η recuperatore ***0,69*** -

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*N*	*1,20*	*16,81*	*0*
W2	*T*	*F2 : 16.6 x 4M*	*1,365*	*-5,1*	*N*	*1,20*	*58,45*	*2403*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*N*	*1,20*	*5,86*	*19*
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*E*	*1,15*	*6,88*	*0*
W4	*T*	*F4 : 29.3 X 4 M*	*1,361*	*-5,1*	*E*	*1,15*	*24,35*	*957*
M7	*T*	*CV7 - Parete vs esterno (con controparete)*	*0,109*	*-5,1*	*E*	*1,15*	*1,95*	*6*
Z11	-	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*OR*	*1,00*	*23,69*	*0*
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*115,60*	*429*

Dispersioni per trasmissione: Φ_{tr}= ***3815***
Dispersioni per ventilazione: Φ_{ve}= ***441***
Dispersioni per intermittenza: Φ_{rh}= ***1654***
Dispersioni totali: Φ_{hl}= ***5909***
Dispersioni totali con coefficiente di sicurezza: $\Phi_{hl\ sic}$= ***5909***

Zona: ***1*** **Locale:** ***39*** **Descrizione:** ***OFF12 - Office***

Superficie in pianta netta ***119,58*** m² Volume netto ***358,74*** m³
Altezza netta ***3,00*** m Ricambio d'aria ***0,53*** 1/h
Temperatura interna ***20,0*** °C Fattore di ripresa ***16*** W/m²
Ventilazione ***Meccanica*** η recuperatore ***0,69*** -

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φtr [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	E	1,15	11,86	0
W4	T	F4 : 29.3 X 4 M	1,361	-5,1	E	1,15	42,41	1667
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	E	1,15	2,96	9
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	8,98	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	34,33	691
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	20,84	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	129,91	483

Dispersioni per trasmissione:	Φ_{tr}=	**2849**
Dispersioni per ventilazione:	Φ_{ve}=	**493**
Dispersioni per intermittenza:	Φ_{rh}=	**1913**
Dispersioni totali:	Φ_{hl}=	**5255**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**5255**

Zona: ***1*** **Locale:** ***40*** **Descrizione:** ***OFF11 - Office***

Superficie in pianta netta	***215,57***	m²	Volume netto	***646,71***	m³
Altezza netta	***3,00***	m	Ricambio d'aria	***0,53***	1/h
Temperatura interna	***20,0***	°C	Fattore di ripresa	***16***	W/m²
Ventilazione	***Meccanica***		η recuperatore	***0,69***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φtr [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	0,20	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	0,78	16
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	4,35	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	16,66	335
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	0,18	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	0,67	13
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	E	1,15	11,14	0
W4	T	F4 : 29.3 X 4 M	1,361	-5,1	E	1,15	38,16	1500
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	E	1,15	4,44	14
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	S	1,00	21,09	0
W2	T	F2 : 16.6 x 4M	1,365	-5,1	S	1,00	59,52	2039
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	S	1,00	21,14	58
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	36,96	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	234,26	870

Dispersioni per trasmissione:	Φ_{tr}=	**4845**
Dispersioni per ventilazione:	Φ_{ve}=	**882**

Dispersioni per intermittenza:	Φ_{rh}=	**3449**
Dispersioni totali:	Φ_{hl}=	**9176**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**9176**

Zona: ***1*** **Locale:** ***41*** **Descrizione:** ***STO13 - Storage***

Superficie in pianta netta	**143,97**	m^2	Volume netto	**734,25**	m^3
Altezza netta	**5,10**	m	Ricambio d'aria	**0,50**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	S	1,00	9,56	0
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	S	1,00	4,52	0
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	S	1,00	84,14	230
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	O	1,10	4,44	0
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	O	1,10	6,73	0
M7	T	CV7 - Parete vs esterno (con controparete)	0,109	-5,1	O	1,10	66,92	201
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	25,0	OR	1,00	14,00	0
P11	A	PV-11: vs DX	0,896	25,0	OR	1,00	66,65	-299
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	27,0	OR	1,00	6,73	0
P12	A	PV-12: vs locale critico	0,896	27,0	OR	1,00	40,11	-252
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	25,25	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	157,27	584

Dispersioni per trasmissione:	Φ_{tr}=	**466**
Dispersioni per ventilazione:	Φ_{ve}=	**960**
Dispersioni per intermittenza:	Φ_{rh}=	**2304**
Dispersioni totali:	Φ_{hl}=	**3729**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**3729**

Zona: ***1*** **Locale:** ***42*** **Descrizione:** ***JAN11 - Janitorial***

Superficie in pianta netta	**6,30**	m^2	Volume netto	**18,90**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**6,35**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	1,98	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	7,59	153
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	2,49	0
M42	U	CV42: vs non climatizzato (vs scala con controparete - 1 parete esterna)	0,354	10,0	-	0,00	9,53	34

Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	10,0	-	0,00	1,82	0
M41	U	CV41: vs non climatizzato (vs scala - semplificato - 1 parete esterna)	2,004	10,0	-	0,00	6,95	140
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	6,29	0
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	9,02	34

Dispersioni per trasmissione:	Φ_{tr}=	**360**
Dispersioni per ventilazione:	Φ_{ve}=	**311**
Dispersioni per intermittenza:	Φ_{rh}=	**101**
Dispersioni totali:	Φ_{hl}=	**772**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**772**

Zona: **1** **Locale:** **43** **Descrizione:** **RES11 - Accessible toilet**

Superficie in pianta netta	**4,86**	m^2	Volume netto	**14,58**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**3,43**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	6,24	23

Dispersioni per trasmissione:	Φ_{tr}=	**23**
Dispersioni per ventilazione:	Φ_{ve}=	**130**
Dispersioni per intermittenza:	Φ_{rh}=	**78**
Dispersioni totali:	Φ_{hl}=	**231**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**231**

Zona: **1** **Locale:** **44** **Descrizione:** **RES13 - Men's toilet**

Superficie in pianta netta	**14,26**	m^2	Volume netto	**42,78**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**3,51**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	16,33	61

Dispersioni per trasmissione:	Φ_{tr}=	**61**
Dispersioni per ventilazione:	Φ_{ve}=	**389**
Dispersioni per intermittenza:	Φ_{rh}=	**228**
Dispersioni totali:	Φ_{hl}=	**678**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**678**

Zona: **1** **Locale:** **45** **Descrizione:** **RES12 - Women's toilet**

Superficie in pianta netta	**14,31**	m^2	Volume netto	**42,93**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**3,49**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	T	CO1 - Verso esterno	0,148	-5,1	OR	1,00	16,38	61

Dispersioni per trasmissione:	Φ_{tr}=	**61**
Dispersioni per ventilazione:	Φ_{ve}=	**389**
Dispersioni per intermittenza:	Φ_{rh}=	**229**
Dispersioni totali:	Φ_{hl}=	**679**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**679**

Zona: **1** **Locale:** **46** **Descrizione:** **CHG12 - Changing room**

Superficie in pianta netta	**19,42**	m^2	Volume netto	**58,26**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**2,57**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*21,98*	*82*

Dispersioni per trasmissione:	Φ_{tr}=	**82**
Dispersioni per ventilazione:	Φ_{ve}=	**389**
Dispersioni per intermittenza:	Φ_{rh}=	**311**
Dispersioni totali:	Φ_{hl}=	**781**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**781**

Zona: **1** **Locale:** **47** **Descrizione:** **CHG11 - Changing room**

Superficie in pianta netta	**19,47**	m^2	Volume netto	**58,41**	m^3
Altezza netta	**3,00**	m	Ricambio d'aria	**2,57**	1/h
Temperatura interna	**20,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
S1	*T*	*CO1 - Verso esterno*	*0,148*	*-5,1*	*OR*	*1,00*	*21,89*	*81*

Dispersioni per trasmissione:	Φ_{tr}=	**81**
Dispersioni per ventilazione:	Φ_{ve}=	**389**
Dispersioni per intermittenza:	Φ_{rh}=	**312**
Dispersioni totali:	Φ_{hl}=	**782**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**782**

Zona: **1** **Locale:** **64** **Descrizione:** **FCR01 - Fire Command Room**

Superficie in pianta netta	**13,88**	m^2	Volume netto	**88,14**	m^3
Altezza netta	**6,35**	m	Ricambio d'aria	**0,57**	1/h
Temperatura interna	**10,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z24	*-*	*GF24 - Parete (locale tecnico) - Solaio controterra*	*0,338*	*-5,1*	*N*	*1,20*	*4,72*	*29*
M83	*T*	*CV83 - Porta da locale tecnico vs esterno*	*0,511*	*-5,1*	*N*	*1,20*	*2,16*	*20*
M2	*T*	*CV2 - Parete vs esterno (con cls - locali tecnici)*	*0,170*	*-5,1*	*N*	*1,20*	*34,17*	*105*
Z21	*-*	*PS1 - Parete con controparete (locale*	*0,332*	*20,0*	*-*	*0,00*	*3,68*	*0*

		riscaldato) - Solaio con vespaio						
M14	U	CV14 - Da tecnico a corridoio (cls espanso - amalitico)	0,706	20,0	-	0,00	28,29	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	3,68	19
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	-5,1	OR	1,00	4,72	24
P7	G	PV7: vs terreno da locale tecnico	0,276	-5,1	OR	1,00	17,02	71

Dispersioni per trasmissione:	Φ_{tr}=	**268**
Dispersioni per ventilazione:	Φ_{ve}=	**78**
Dispersioni per intermittenza:	Φ_{rh}=	**222**
Dispersioni totali:	Φ_{hl}=	**568**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**568**

Zona: **1** **Locale:** **65** **Descrizione:** **WAT01 - Water Room**

Superficie in pianta netta	**14,04**	m²	Volume netto	**89,16**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**2,80**	1/h
Temperatura interna	**10,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	-5,1	N	1,20	4,70	29
M83	T	CV83 - Porta da locale tecnico vs esterno	0,511	-5,1	N	1,20	2,16	20
M2	T	CV2 - Parete vs esterno (con cls - locali tecnici)	0,170	-5,1	N	1,20	33,98	104
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	-5,1	OR	1,00	4,70	24
P7	G	PV7: vs terreno da locale tecnico	0,276	-5,1	OR	1,00	16,59	69

Dispersioni per trasmissione:	Φ_{tr}=	**246**
Dispersioni per ventilazione:	Φ_{ve}=	**390**
Dispersioni per intermittenza:	Φ_{rh}=	**225**
Dispersioni totali:	Φ_{hl}=	**861**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**861**

Zona: **1** **Locale:** **66** **Descrizione:** **SPK01 - Sprinkler room**

Superficie in pianta netta	**19,24**	m²	Volume netto	**122,17**	m³
Altezza netta	**6,35**	m	Ricambio d'aria	**0,49**	1/h
Temperatura interna	**10,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,69**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	-5,1	N	1,20	3,25	20
M2	T	CV2 - Parete vs esterno (con cls - locali tecnici)	0,170	-5,1	N	1,20	25,03	77
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	6,88	14
M13	U	CV13 - vs locale tecnico (cls	0,706	10,0	-	0,00	52,88	224

		espanso)						
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	6,88	35
Z24	-	GF24 - Parete (locale tecnico) - Solaio controterra	0,338	-5,1	OR	1,00	3,25	17
P7	G	PV7: vs terreno da locale tecnico	0,276	-5,1	OR	1,00	16,93	70

Dispersioni per trasmissione:	Φ_{tr}=	**457**
Dispersioni per ventilazione:	Φ_{ve}=	**94**
Dispersioni per intermittenza:	Φ_{rh}=	**308**
Dispersioni totali:	Φ_{hl}=	**859**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**859**

Zona 2 - Zona critica

Dettaglio del fabbisogno di potenza dei locali

Zona: **2** **Locale:** **1** **Descrizione:** **SH01 - Data Hall**

Superficie in pianta netta	**1936,39**	m^2	Volume netto	**8520,11**	m^3
Altezza netta	**4,40**	m	Ricambio d'aria	**0,16**	1/h
Temperatura interna	**27,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z26	-	GF26 - Parete (DM) - Solaio controterra	0,338	-5,1	N	1,20	80,04	1041
M4	T	CV4 - Parete vs esterno (con cls - mechanical gallery) (?)	0,170	-5,1	N	1,20	485,47	3171
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	0,20	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,50	0
M61	U	CV61 - Porta mechanical gallery vs corridoio COR02 (analitico)	0,489	20,0	-	0,00	2,16	0
M19	U	CV19 - Da Mechanical Gallery a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	26,34	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	0,20	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,50	0
M61	U	CV61 - Porta mechanical gallery vs corridoio COR02 (analitico)	0,489	20,0	-	0,00	2,16	0
M19	U	CV19 - Da Mechanical Gallery a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	26,34	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,90	0

M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	1,98	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	27,71	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,65	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	9,98	90
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	11,28	48
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	68,42	620
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,65	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	10,04	91
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,47	0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	1,98	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	25,15	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	80,05	1
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	5,04	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	480,49	7
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,47	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	27,13	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,60	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	9,70	88
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	11,43	49
M20	U	CV20 - Da locale critico a cavedio(cls espanso -	0,706	10,0	-	0,00	69,29	628

		semplificato - 1 parete vs esterno)						
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,60	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	9,70	88
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,75	0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	1,98	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	26,84	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	128,25	1390
P4	G	PV4: vs terreno da locale critico	0,012	-5,1	OR	1,00	1632,02	609
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	9,00	98
Z26	-	GF26 - Parete (DM) - Solaio controterra	0,338	-5,1	OR	1,00	80,04	868
P5	G	PV5: vs terreno da locale critico ritorno crah	0,303	-5,1	OR	1,00	360,32	3503
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	137,26	0
Z2	-	PC2 - Parete blocchetti (mechanical gallery) - Copertura	-0,032	-5,1	OR	1,00	80,04	-83
S2	T	CO2 - Verso esterno da DM	0,148	-5,1	OR	1,00	1992,33	9466

Dispersioni per trasmissione:	Φ_{tr}=	**21804**
Dispersioni per ventilazione:	Φ_{ve}=	**14980**
Dispersioni per intermittenza:	Φ_{rh}=	**30982**
Dispersioni totali:	Φ_{hl}=	**67766**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**67766**

Zona: **2** **Locale:** **2** **Descrizione:** **MMR02- MMR/POE**

Superficie in pianta netta	**29,53**	m^2	Volume netto	**186,04**	m^3
Altezza netta	**6,30**	m	Ricambio d'aria	**0,27**	1/h
Temperatura interna	**27,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,14	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	33,01	1
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	7,91	0
M68	U	CV68 - Porta locale DX vs locali corridoio (analitico)	0,489	20,0	-	0,00	1,98	0

M68	U	CV68 - Porta locale DX vs locali corridoio (analitico)	0,489	20,0	-	0,00	5,04	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	55,95	1
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	4,14	3
M32	A	CV32 - Da locale critico a DX (cls espanso)	0,706	25,0	-	0,00	33,01	47
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	5,34	23
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	42,50	385
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	2,57	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	20,47	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	24,10	261
P4	G	PV4: vs terreno da locale critico	0,012	-5,1	OR	1,00	32,77	12
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	24,10	0
S2	T	CO2 - Verso esterno da DM	0,148	-5,1	OR	1,00	32,77	156

Dispersioni per trasmissione:	Φ_{tr}=	**888**
Dispersioni per ventilazione:	Φ_{ve}=	**535**
Dispersioni per intermittenza:	Φ_{rh}=	**472**
Dispersioni totali:	Φ_{hl}=	**1896**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1896**

Zona: **2** **Locale:** **23** **Descrizione:** **ER01 - Electrical room**

Superficie in pianta netta	**20,25**	m^2	Volume netto	**127,78**	m^3
Altezza netta	**6,31**	m	Ricambio d'aria	**0,55**	1/h
Temperatura interna	**25,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	4,72	19
M26	U	CV26 - Da locale DX a tecnico (cls espanso)	0,706	10,0	-	0,00	36,24	307
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	3,16	0
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	24,24	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	6,65	0

M73	A	CV73 - Porta vs locale DX	0,489	25,0	-	0,00	1,98	0
M73	A	CV73 - Porta vs locale DX	0,489	25,0	-	0,00	5,04	0
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	43,98	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	3,34	0
M17	U	CV17 - Da DX a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	25,62	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	17,87	182
P3	G	PV3: vs terreno da locale dx	0,436	-5,1	OR	1,00	22,31	293
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	20,0	OR	1,00	17,87	0
S6	A	SF-01: da DX vs ufficio	1,606	20,0	OR	1,00	22,31	179

Dispersioni per trasmissione:	Φ_{tr}=	**980**
Dispersioni per ventilazione:	Φ_{ve}=	**702**
Dispersioni per intermittenza:	Φ_{rh}=	**324**
Dispersioni totali:	Φ_{hl}=	**2006**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**2006**

Zona: **2** **Locale:** **24** **Descrizione:** **ER02 - Electrical Room**

Superficie in pianta netta	**22,05**	m²	Volume netto	**139,13**	m³
Altezza netta	**6,31**	m	Ricambio d'aria	**0,50**	1/h
Temperatura interna	**25,0**	°C	Fattore di ripresa	**16**	W/m²
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	3,56	0
M73	A	CV73 - Porta vs locale DX	0,489	25,0	-	0,00	2,16	0
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	25,11	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	6,62	0
M31	A	CV31 - vs DX	0,706	25,0	-	0,00	50,79	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	3,55	0
M32	A	CV32 - Da locale critico a DX (cls espanso)	0,706	25,0	-	0,00	27,27	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	13,73	140
P3	G	PV3: vs terreno da locale dx	0,436	-5,1	OR	1,00	23,56	309
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	20,0	OR	1,00	13,73	0
S6	A	SF-01: da DX vs ufficio	1,606	20,0	OR	1,00	23,56	189

Dispersioni per trasmissione:	Φ_{tr}=	**638**
Dispersioni per ventilazione:	Φ_{ve}=	**702**
Dispersioni per intermittenza:	Φ_{rh}=	**353**
Dispersioni totali:	Φ_{hl}=	**1693**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**1693**

Zona: ***2*** **Locale:** ***25*** **Descrizione:** ***CER01 - Comunication equipment room***

Superficie in pianta netta	***35,59***	m^2	Volume netto	***224,57***	m^3
Altezza netta	***6,31***	m	Ricambio d'aria	***0,53***	1/h
Temperatura interna	***25,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,00***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*5,72*	*0*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*5,04*	*0*
M73	*A*	*CV73 - Porta vs locale DX*	*0,489*	*25,0*	*-*	*0,00*	*1,98*	*0*
M31	*A*	*CV31 - vs DX*	*0,706*	*25,0*	*-*	*0,00*	*36,85*	*0*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*5,72*	*0*
M32	*A*	*CV32 - Da locale critico a DX (cls espanso)*	*0,706*	*25,0*	*-*	*0,00*	*43,87*	*0*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*20,0*	*-*	*0,00*	*6,62*	*0*
M17	*U*	*CV17 - Da DX a corridio COR02 (cls espanso - analitico)*	*0,706*	*20,0*	*-*	*0,00*	*50,81*	*1*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*18,06*	*184*
P3	*G*	*PV3: vs terreno da locale dx*	*0,436*	*-5,1*	*OR*	*1,00*	*37,90*	*498*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*20,0*	*OR*	*1,00*	*18,06*	*0*
S6	*A*	*SF-01: da DX vs ufficio*	*1,606*	*20,0*	*OR*	*1,00*	*37,90*	*304*

Dispersioni per trasmissione:	Φ_{tr}=	***987***
Dispersioni per ventilazione:	Φ_{ve}=	***1204***
Dispersioni per intermittenza:	Φ_{rh}=	***569***
Dispersioni totali:	Φ_{hl}=	***2760***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***2760***

Zona: ***2*** **Locale:** ***26*** **Descrizione:** ***MMR01 - MMR / POE***

Superficie in pianta netta	***36,35***	m^2	Volume netto	***229,37***	m^3
Altezza netta	***6,31***	m	Ricambio d'aria	***0,52***	1/h
Temperatura interna	***27,0***	°C	Fattore di ripresa	***16***	W/m^2
Ventilazione	***Meccanica***		η recuperatore	***0,00***	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*9,27*	*6*
M32	*A*	*CV32 - Da locale critico a DX (cls espanso)*	*0,706*	*25,0*	*-*	*0,00*	*71,08*	*100*
Z21	*-*	*PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio*	*0,332*	*25,0*	*-*	*0,00*	*4,54*	*3*

M31	A	CV31 - vs DX	0,706	25,0	-	0,00	34,81	49
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	S	1,00	9,27	100
M86	T	CV86 - Porta locale locale critico vs esterno	0,511	-5,1	S	1,00	2,16	35
M9	T	CV9 - Parete vs esterno (con cls - locale critico)	0,170	-5,1	S	1,00	68,92	375
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,54	0
M68	U	CV68 - Porta locale DX vs locali corridoio (analitico)	0,489	20,0	-	0,00	1,98	0
M68	U	CV68 - Porta locale DX vs locali corridoio (analitico)	0,489	20,0	-	0,00	5,04	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	27,79	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	27,61	299
P4	G	PV4: vs terreno da locale critico	0,012	-5,1	OR	1,00	42,07	16
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	20,0	OR	1,00	18,35	0
Z13	-	PI3 - Parete blocchetti - Solaio interpiano (locale DX)	0,000	20,0	OR	1,00	9,27	0
S10	A	SF-01: da locale critico vs ufficio	1,606	20,0	OR	1,00	42,07	473

Dispersioni per trasmissione:	Φ_{tr}=	**1458**
Dispersioni per ventilazione:	Φ_{ve}=	**1284**
Dispersioni per intermittenza:	Φ_{rh}=	**582**
Dispersioni totali:	Φ_{hl}=	**3324**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**3324**

Zona: **2** **Locale:** **29** **Descrizione:** **CER02 - Comunications Equipments Room**

Superficie in pianta netta	**23,72**	m^2	Volume netto	**149,44**	m^3
Altezza netta	**6,30**	m	Ricambio d'aria	**0,67**	1/h
Temperatura interna	**25,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	25,0	-	0,00	4,15	0
M32	A	CV32 - Da locale critico a DX (cls espanso)	0,706	25,0	-	0,00	33,06	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	6,31	0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	1,98	0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	5,04	0
M17	U	CV17 - Da DX a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	43,24	1
Z21	-	PS1 - Parete con	0,332	10,0	-	0,00	6,23	25

		controparete (locale riscaldato) - Solaio con vespaio						
M23	U	CV23 - Da DX a cavedio (cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	49,66	422
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	16,69	170
P3	G	PV3: vs terreno da locale dx	0,436	-5,1	OR	1,00	26,03	342
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	16,69	0
S4	T	CO4 - Verso esterno da DX	0,148	-5,1	OR	1,00	26,03	116

Dispersioni per trasmissione:	Φ_{tr}=	**1075**
Dispersioni per ventilazione:	Φ_{ve}=	**1003**
Dispersioni per intermittenza:	Φ_{rh}=	**380**
Dispersioni totali:	Φ_{hl}=	**2458**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**2458**

Zona: **2** **Locale:** **30** **Descrizione:** **DH02 - Data Hall**

Superficie in pianta netta	**1917,11**	m^2	Volume netto	**8435,28**	m^3
Altezza netta	**4,40**	m	Ricambio d'aria	**0,17**	1/h
Temperatura interna	**27,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
Z26	-	GF26 - Parete (DM) - Solaio controterra	0,338	-5,1	N	1,20	78,15	1017
M4	T	CV4 - Parete vs esterno (con cls - mechanical gallery) (?)	0,170	-5,1	N	1,20	473,97	3096
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,69	0
M61	U	CV61 - Porta mechanical gallery vs corridoio COR02 (analitico)	0,489	20,0	-	0,00	2,16	0
M19	U	CV19 - Da Mechanical Gallery a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	26,32	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	1,59	0
M19	U	CV19 - Da Mechanical Gallery a corridio COR02 (cls espanso - analitico)	0,706	20,0	-	0,00	9,67	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,47	0
M74	U	CV74 - Porta locali critici vs corridoio COR03(analitico)	0,489	20,0	-	0,00	1,98	0
M11	U	CV11 - Da locale critico a corridio COR03(cls espanso - analitico)	0,706	20,0	-	0,00	25,15	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,60	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso -	0,706	10,0	-	0,00	9,70	88

		semplificato - 1 parete vs esterno)						
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	13,88	59
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	84,18	763
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,53	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	9,25	84
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	2,25	0
M11	U	CV11 - Da locale critico a corridio COR03(cls espanso - analitico)	0,706	20,0	-	0,00	13,66	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	1,90	0
M74	U	CV74 - Porta locali critici vs corridoio COR03(analitico)	0,489	20,0	-	0,00	1,98	0
M11	U	CV11 - Da locale critico a corridio COR03(cls espanso - analitico)	0,706	20,0	-	0,00	9,52	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,60	0
M67	U	CV67 - Porta locali critici vs corridoio COR02(analitico)	0,489	20,0	-	0,00	1,98	0
M34	U	CV34 - Da locale critico a corridio COR02(cls espanso - analitico)	0,706	20,0	-	0,00	25,93	0
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	11,58	49
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	70,20	636
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	1,59	7
M20	U	CV20 - Da locale critico a cavedio(cls espanso - semplificato - 1 parete vs esterno)	0,706	10,0	-	0,00	9,67	88
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	10,0	-	0,00	4,47	19
M22	U	CV22 - Da locale critico a tecnico (cls espanso)	0,706	10,0	-	0,00	27,13	245
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con	0,332	20,0	-	0,00	80,04	1

		vespaio						
M74	U	CV74 - Porta locali critici vs corridoio COR03(analitico)	0,489	20,0	-	0,00	5,04	0
M11	U	CV11 - Da locale critico a corridio COR03(cls espanso - analitico)	0,706	20,0	-	0,00	480,43	8
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,55	0
M76	U	CV76 - Porta mechanical gallery vs corridoio COR03 (analitico)	0,489	20,0	-	0,00	2,16	0
M36	U	CV36 - Da Mechanical Gallery a corridio COR03 (cls espanso - analitico)	0,706	20,0	-	0,00	25,44	0
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	127,92	1387
P4	G	PV4: vs terreno da locale critico	0,012	-5,1	OR	1,00	1605,20	599
Z23	-	GF23 - Parete (locale critico) - Solaio controterra	0,338	-5,1	OR	1,00	10,84	118
Z26	-	GF26 - Parete (DM) - Solaio controterra	0,338	-5,1	OR	1,00	78,15	847
P5	G	PV5: vs terreno da locale critico ritorno crah	0,303	-5,1	OR	1,00	367,27	3571
Z11	-	PI1 - Parete con controparete - Solaio interpiano	0,000	-5,1	OR	1,00	138,76	0
Z2	-	PC2 - Parete blocchetti (mechanical gallery) - Copertura	-0,032	-5,1	OR	1,00	78,15	-81
S2	T	CO2 - Verso esterno da DM	0,148	-5,1	OR	1,00	1971,98	9370

Dispersioni per trasmissione:	Φ_{tr}=	**21985**
Dispersioni per ventilazione:	Φ_{ve}=	**14980**
Dispersioni per intermittenza:	Φ_{rh}=	**30674**
Dispersioni totali:	Φ_{hl}=	**67638**
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	**67638**

Zona: **2** **Locale:** **31** **Descrizione:** **IDF01 - IDF**

Superficie in pianta netta	**6,67**	m^2	Volume netto	**40,69**	m^3
Altezza netta	**6,10**	m	Ricambio d'aria	**1,23**	1/h
Temperatura interna	**25,0**	°C	Fattore di ripresa	**16**	W/m^2
Ventilazione	**Meccanica**		η recuperatore	**0,00**	-

Cod	Tipo	Descrizione elemento	U [W/m²K] Ψ[W/mK]	θe [°C]	Esp	ce	Sup.[m²] Lungh.[m]	Φ_{tr} [W]
M3	T	CV3 - Parete vs esterno (con cls - locali DX)	0,170	-5,1	N	1,20	17,73	109
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	4,53	0
M75	U	CV75 - Porta locale DX vs locali corridoio COR03 (analitico)	0,489	20,0	-	0,00	2,16	0
M35	U	CV35 - Da DX a corridio COR03 (cls espanso - analitico)	0,706	20,0	-	0,00	33,05	1
Z21	-	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	0,332	20,0	-	0,00	2,29	0

M35	*U*	*CV35 - Da DX a corridio COR03 (cls espanso - analitico)*	*0,706*	*20,0*	*-*	*0,00*	*17,77*	*0*
M3	*T*	*CV3 - Parete vs esterno (con cls - locali DX)*	*0,170*	*-5,1*	*O*	*1,10*	*35,21*	*198*
Z25	*-*	*GF25 - Parete (locale DX) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*2,28*	*23*
Z23	*-*	*GF23 - Parete (locale critico) - Solaio controterra*	*0,338*	*-5,1*	*OR*	*1,00*	*11,36*	*115*
P3	*G*	*PV3: vs terreno da locale dx*	*0,436*	*-5,1*	*OR*	*1,00*	*10,37*	*136*
Z11	*-*	*PI1 - Parete con controparete - Solaio interpiano*	*0,000*	*-5,1*	*OR*	*1,00*	*6,82*	*0*
Z2	*-*	*PC2 - Parete blocchetti (mechanical gallery) - Copertura*	*-0,032*	*-5,1*	*OR*	*1,00*	*6,82*	*-7*
S4	*T*	*CO4 - Verso esterno da DX*	*0,148*	*-5,1*	*OR*	*1,00*	*10,37*	*46*

Dispersioni per trasmissione:	Φ_{tr}=	***622***
Dispersioni per ventilazione:	Φ_{ve}=	***502***
Dispersioni per intermittenza:	Φ_{rh}=	***107***
Dispersioni totali:	Φ_{hl}=	***1230***
Dispersioni totali con coefficiente di sicurezza:	$\Phi_{hl\ sic}$=	***1230***

Legenda simboli

U	Trasmittanza termica dell'elemento disperdente
Ψ	Trasmittanza termica lineica del ponte termico
θe	Temperatura di esposizione dell'elemento
Esp	Esposizione dell'elemento
ce	Coefficiente di esposizione solare
Sup	Superficie dell'elemento disperdente
Lungh	Lunghezza del ponte termico
Φ_{tr}	Potenza dispersa per trasmissione

RIASSUNTO DISPERSIONI DEI LOCALI

Opzioni di calcolo:

Metodologia di calcolo ***Vicini presenti***

Coefficiente di sicurezza adottato ***1,00*** -

Zona 1 - Zona uffici fabbisogno di potenza dei locali

Loc	Descrizione	θi [°C]	n [1/h]	Φ_{tr} [W]	Φ_{ve} [W]	Φ_{rh} [W]	Φ_{hl} [W]	$\Phi_{hl\ sic}$ [W]
1	RES03 - Men's toilet	20,0	3,51	95	389	228	712	712
2	SOC01 - SOC storage	20,0	0,66	392	130	190	711	711
3	SOC02 - Security operation center	20,0	0,66	1233	207	643	2083	2083
4	SOC03 - SOC Manager Office	20,0	1,36	402	130	196	727	727
5	BRK02 - Break Room	20,0	2,40	489	571	489	1548	1548
6	LOB01 - Lobby	20,0	0,69	930	259	776	1966	1966
7	CON01 - Conference Room	20,0	0,60	1241	467	752	2460	2460
8	CON02 - Magazzino sala conferenze	20,0	3,31	12	130	38	180	180
9	SHP01 - Loading-unloading area	20,0	0,41	2813	830	1967	5610	5610
10	OFF01 - Asset managment office	20,0	1,70	504	130	157	791	791
11	EVR02 - Freight elevator	20,0	0,50	121	126	245	492	492
12	STG01 - Staging-Receiving Area	20,0	0,44	740	467	1033	2240	2240
13	SHF02 - Shaft	20,0	1,39	55	130	91	275	275
14	STO02- Storage	20,0	0,51	464	519	996	1979	1979
15	VST01 - Disimpegno	20,0	4,55	18	130	59	207	207
16	VST02 - Disimpegno	20,0	6,46	13	130	41	184	184
17	RES04 - Unisex toilet	20,0	3,26	87	130	82	299	299
18	RES05 - Accessible toilet	20,0	4,83	62	130	55	246	246
19	JAN01 - Janitorial	20,0	6,38	638	441	142	1221	1221
20	RES01 - Accessible toillet	20,0	3,44	36	130	78	244	244
21	RES02 - Women's toilet	20,0	3,50	96	389	228	713	713
22	STO01 - Storage	20,0	0,53	257	363	665	1285	1285
23	SHF01 - Shaft	20,0	1,01	-40	130	125	215	215
24	COR01 - Corridor	20,0	0,50	1593	1159	2252	5005	5005
25	SHF01 - Shaft	20,0	0,96	34	130	132	295	295
26	SHF02 - Shaft	20,0	1,77	59	130	91	279	279
27	EVR02 - Frieght elevator	20,0	0,50	175	421	253	849	849
28	BRK01 - Break Room	20,0	0,69	839	259	366	1464	1464
29	STR02 - Safe waiting area	20,0	0,50	176	15	37	229	229
30	COR11 - Corridor	20,0	0,50	1479	1023	1988	4491	4491
31	SPK02 - Sprinkler room	20,0	0,50	263	130	257	649	649

36	STO12 - Storage	20,0	0,53	736	337	782	1855	1855
37	STO11 - Storage	20,0	0,52	631	363	860	1855	1855
38	OFF13 - Office	20,0	0,55	3815	441	1654	5909	5909
39	OFF12 - Office	20,0	0,53	2849	493	1913	5255	5255
40	OFF11 - Office	20,0	0,53	4845	882	3449	9176	9176
41	STO13 - Storage	20,0	0,50	466	960	2304	3729	3729
42	JAN11 - Janitorial	20,0	6,35	360	311	101	772	772
43	RES11 - Accessible toilet	20,0	3,43	23	130	78	231	231
44	RES13 - Men's toilet	20,0	3,51	61	389	228	678	678
45	RES12 - Women's toilet	20,0	3,49	61	389	229	679	679
46	CHG12 - Changing room	20,0	2,57	82	389	311	781	781
47	CHG11 - Changing room	20,0	2,57	81	389	312	782	782
64	FCR01 - Fire Command Room	10,0	0,57	268	78	222	568	568
65	WAT01 - Water Room	10,0	2,80	246	390	225	861	861
66	SPK01 - Sprinkler room	10,0	0,49	457	94	308	859	859
			Totale:	**30259**	**15756**	**27627**	**73642**	**73642**

Zona 2 - Zona critica fabbisogno di potenza dei locali

Loc	Descrizione	θi [°C]	n [1/h]	Φ_{tr} [W]	Φ_{ve} [W]	Φ_{rh} [W]	Φ_{hl} [W]	$\Phi_{hl\ sic}$ [W]
1	SH01 - Data Hall	27,0	0,16	21804	14980	30982	67766	67766
2	MMR02- MMR/POE	27,0	0,27	888	535	472	1896	1896
23	ER01 - Electrical room	25,0	0,55	980	702	324	2006	2006
24	ER02 - Electrical Room	25,0	0,50	638	702	353	1693	1693
25	CER01 - Comunication equipment room	25,0	0,53	987	1204	569	2760	2760
26	MMR01 - MMR / POE	27,0	0,52	1458	1284	582	3324	3324
29	CER02 - Comunications Equipments Room	25,0	0,67	1075	1003	380	2458	2458
30	DH02 - Data Hall	27,0	0,17	21985	14980	30674	67638	67638
31	IDF01 - IDF	25,0	1,23	622	502	107	1230	1230
			Totale:	**50436**	**35893**	**64443**	**150771**	**150771**
			Totale Edifico:	**80695**	**51649**	**92069**	**224413**	**224413**

Legenda simboli

θi	Temperatura interna del locale
n	Ricambio d'aria del locale
Φ_{tr}	Potenza dispersa per trasmissione
Φ_{ve}	Potenza dispersa per ventilazione
Φ_{rh}	Potenza dispersa per intermittenza
Φ_{hl}	Potenza totale dispersa
$\Phi_{hl\ sic}$	Potenza totale moltiplicata per il coefficiente di sicurezza

RIASSUNTO DISPERSIONI DELLE ZONE

Opzioni di calcolo:

Metodologia di calcolo	***Vicini presenti***	
Coefficiente di sicurezza adottato	***1,00***	-

Dati geometrici delle zone termiche:

Zona	Descrizione	V [m³]	V_{netto} [m³]	S_u [m²]	S_{lorda} [m²]	S [m²]	S/V [-]
1	*Zona uffici*	*10958,40*	*8235,89*	*1726,68*	*1915,60*	*3739,03*	*0,34*
2	*Zona critica*	*25560,59*	*18052,41*	*4027,66*	*4159,82*	*11410,07*	*0,45*
	Totale:	***36519,00***	***26288,30***	***5754,34***	***6075,41***	***15149,10***	***0,41***

Fabbisogno di potenza delle zone termiche

Zona	Descrizione	Φ_{tr} [W]	Φ_{ve} [W]	Φ_{rh} [W]	Φ_{hl} [W]	$\Phi_{hl\ sic}$ [W]
1	*Zona uffici*	*30259*	*15756*	*27627*	*73642*	*73642*
2	*Zona critica*	*50436*	*35893*	*64443*	*150771*	*150771*
	Totale:	***80695***	***51649***	***92069***	***224413***	***224413***

Legenda simboli

V	Volume lordo
V_{netto}	Volume netto
S_u	Superficie in pianta netta
S_{lorda}	Superficie in pianta lorda
S	Superficie esterna lorda (senza strutture di tipo N)
S/V	Fattore di forma
Φ_{tr}	Potenza dispersa per trasmissione
Φ_{ve}	Potenza dispersa per ventilazione
Φ_{rh}	Potenza dispersa per intermittenza
Φ_{hl}	Potenza totale dispersa
$\Phi_{hl\ sic}$	Potenza totale moltiplicata per il coefficiente di sicurezza

DATI CLIMATICI DELLA LOCALITÀ

Caratteristiche geografiche

Località		***Siziano***		
Provincia		***Pavia***		
Altitudine s.l.m.			***93***	m
Latitudine nord	***45° 18'***	Longitudine est	***9° 12'***	
Gradi giorno			***2601***	
Zona climatica			***E***	

Località di riferimento

per dati invernali	***Pavia***
per dati estivi	***Pavia***

Stazioni di rilevazione

per la temperatura	***S.Angelo Lodigiano***
per l'irradiazione	***S.Angelo Lodigiano***
per il vento	***S.Angelo Lodigiano***

Caratteristiche del vento

Regione di vento:	***A***	
Direzione prevalente	***Sud-Ovest***	
Distanza dal mare	***> 40***	km
Velocità media del vento	***0,7***	m/s
Velocità massima del vento	***1,4***	m/s

Dati invernali

Temperatura esterna di progetto	***-5,1***	°C
Stagione di riscaldamento convenzionale	dal ***15 ottobre*** al ***15 aprile***	

Dati estivi

Temperatura esterna bulbo asciutto	***32,0***	°C
Temperatura esterna bulbo umido	***23,6***	°C
Umidità relativa	***50,0***	%
Escursione termica giornaliera	***12***	°C

Temperature esterne medie mensili

Descrizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Temperatura	°C	*1,4*	*4,5*	*9,4*	*12,6*	*18,4*	*22,4*	*24,1*	*22,6*	*17,8*	*14,1*	*6,4*	*1,5*

Irradiazione solare media mensile

Esposizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Nord	MJ/m²	*1,6*	*2,4*	*3,7*	*5,3*	*8,4*	*10,2*	*9,7*	*6,8*	*4,5*	*2,8*	*1,8*	*1,3*
Nord-Est	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Est	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Sud-Est	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Sud	MJ/m²	*10,1*	*11,2*	*13,4*	*10,6*	*10,5*	*10,6*	*11,1*	*11,3*	*12,6*	*8,7*	*10,7*	*7,6*
Sud-Ovest	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Ovest	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Nord-Ovest	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Orizz. Diffusa	MJ/m²	*2,1*	*3,2*	*4,7*	*6,6*	*9,5*	*9,6*	*9,0*	*7,5*	*5,7*	*4,1*	*2,5*	*1,9*
Orizz. Diretta	MJ/m²	*2,9*	*4,6*	*8,6*	*9,5*	*11,1*	*14,1*	*15,1*	*12,2*	*9,8*	*3,8*	*3,5*	*1,9*

Irradianza sul piano orizzontale nel mese di massima insolazione: ***279*** W/m²

SOMMARIO CARICHI TERMICI nell'ora di massimo carico della zona

ZONA: ***1*** ***Zona uffici***

Mese: ***Luglio***

Ora di massimo carico della zona: ***10***

Efficienza recupero sensibile: ***0,67***
Efficienza recupero latente: ***0,26***

Carichi termici nell'ora di massimo carico della zona:

N.	Descrizione	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
2	SOC01 - SOC storage	0	5	144	387	258	277	536
3	SOC02 - Security operation center	895	14	231	1738	2377	500	2877
4	SOC03 - SOC Manager Office	299	5	145	790	960	278	1239
5	BRK02 - Break Room	218	4	638	2950	2080	1729	3810
6	LOB01 - Lobby	4377	12	291	1655	5707	628	6335
7	CON01 - Conference Room	5044	21	519	3346	7454	1476	8930
9	SHP01 - Loading-unloading area	0	17	928	1892	1499	1339	2837
10	OFF01 - Asset managment office	0	0	145	766	633	279	912
12	STG01 - Staging-Receiving Area	0	0	523	1048	861	709	1571
14	STO02- Storage	0	0	584	890	777	698	1474
22	STO01 - Storage	0	0	405	684	562	527	1089
28	BRK01 - Break Room	0	0	290	1627	1290	627	1917
36	STO12 - Storage	0	5	375	757	639	498	1137
37	STO11 - Storage	56	6	405	806	746	527	1273
38	OFF13 - Office	9525	74	494	3038	12239	892	13130
39	OFF12 - Office	11831	44	551	3200	14680	946	15626
40	OFF11 - Office	16771	96	1874	5830	22011	2559	24571
41	STO13 - Storage	0	50	1064	1708	1665	1156	2821
	Totali	49016	352	9607	33111	76440	15645	92086

Legenda simboli

Q_{Irr} Carico dovuto all'irraggiamento
Q_{Tr} Carico dovuto alla trasmissione
Q_v Carico dovuto alla ventilazione
Q_c Carichi interni
$Q_{gl,sen}$ Carico sensibile globale
$Q_{gl,lat}$ Carico latente globale
Q_{gl} Carico globale

ZONA: ***2*** ***Zona critica***

Mese: ***Luglio***

Ora di massimo carico della zona: ***16***

Carichi termici nell'ora di massimo carico della zona:

N.	Descrizione	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
1	SH01 - Data Hall	0	981	7170	268	3442	4977	8418
2	MMR02- MMR/POE	0	201	661	268	559	572	1130
23	ER01 - Electrical room	0	105	479	268	400	453	853
24	ER02 - Electrical Room	0	38	466	268	327	445	772
25	CER01 - Comunication equipment room	0	118	813	268	516	683	1199
26	MMR01 - MMR / POE	0	33	590	268	355	537	892
29	CER02 - Comunications Equipments Room	0	130	501	268	420	479	899
30	DH02 - Data Hall	0	971	7098	268	3408	4929	8337
31	IDF01 - IDF	0	80	335	268	324	359	684
	Totali	0	2658	18113	2412	9750	13433	23183

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Q_v	Carico dovuto alla ventilazione
Q_c	Carichi interni
$Q_{gl,sen}$	Carico sensibile globale
$Q_{gl,lat}$	Carico latente globale
Q_{gl}	Carico globale

SOMMARIO CARICHI TERMICI
nell'ora di massimo carico di ciascun locale

ZONA: ***1*** ***Zona uffici***

Mese: ***Luglio***

Efficienza recupero sensibile: ***0,67***

Efficienza recupero latente: ***0,26***

Carichi termici nell'ora di massimo carico di ciascun locale:

N.	Descrizione	Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
2	SOC01 - SOC storage	16	0	33	188	387	320	288	608
3	SOC02 - Security operation center	16	1151	176	301	1738	2850	517	3367
4	SOC03 - SOC Manager Office	16	384	58	189	790	1134	289	1422
5	BRK02 - Break Room	16	281	60	834	2950	2349	1776	4125
6	LOB01 - Lobby	10	4377	12	291	1655	5707	628	6335
7	CON01 - Conference Room	10	5044	21	519	3346	7454	1476	8930
9	SHP01 - Loading-unloading area	14	0	382	1212	1892	2080	1406	3486
10	OFF01 - Asset managment office	14	0	20	190	766	687	289	976
12	STG01 - Staging-Receiving Area	16	0	27	683	1048	1010	747	1757
14	STO02- Storage	16	0	25	763	890	938	740	1678
22	STO01 - Storage	14	0	0	530	684	657	557	1214
28	BRK01 - Break Room	16	0	54	379	1627	1412	648	2060
36	STO12 - Storage	16	0	60	491	757	782	526	1308
37	STO11 - Storage	16	72	56	530	806	908	556	1464
38	OFF13 - Office	10	9525	74	494	3038	12239	892	13130
39	OFF12 - Office	10	11831	44	551	3200	14680	946	15626
40	OFF11 - Office	12	16755	448	2313	5830	22584	2761	25345
41	STO13 - Storage	16	0	187	1390	1708	2052	1233	3285
		Totali	49420	1737	11849	33111	79843	16273	96117

Legenda simboli

Q_{Irr} Carico dovuto all'irraggiamento
Q_{Tr} Carico dovuto alla trasmissione
Q_v Carico dovuto alla ventilazione
Q_c Carichi interni
$Q_{gl,sen}$ Carico sensibile globale
$Q_{gl,lat}$ Carico latente globale
Q_{gl} Carico globale

ZONA: ***2*** ***Zona critica***

Mese: ***Luglio***

Carichi termici nell'ora di massimo carico di ciascun locale:

N.	Descrizione	Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
1	SH01 - Data Hall	18	0	2138	6233	268	4012	4627	8640

2	*MMR02- MMR/POE*	*16*	*0*	*201*	*661*	*268*	*559*	*572*	*1130*
23	*ER01 - Electrical room*	*14*	*0*	*105*	*479*	*268*	*400*	*453*	*853*
24	*ER02 - Electrical Room*	*14*	*0*	*38*	*466*	*268*	*327*	*445*	*772*
25	*CER01 - Comunication equipment room*	*14*	*0*	*118*	*813*	*268*	*516*	*683*	*1199*
26	*MMR01 - MMR / POE*	*16*	*0*	*33*	*590*	*268*	*355*	*537*	*892*
29	*CER02 - Comunications Equipments Room*	*16*	*0*	*130*	*501*	*268*	*420*	*479*	*899*
30	*DH02 - Data Hall*	*18*	*0*	*2117*	*6171*	*268*	*3973*	*4583*	*8556*
31	*IDF01 - IDF*	*16*	*0*	*80*	*335*	*268*	*324*	*359*	*684*
		Totali	*0*	*4961*	*16250*	*2412*	*10885*	*12738*	*23623*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Q_v	Carico dovuto alla ventilazione
Q_c	Carichi interni
$Q_{gl,sen}$	Carico sensibile globale
$Q_{gl,lat}$	Carico latente globale
Q_{gl}	Carico globale

DETTAGLIO LOCALI
Distinta dei carichi termici estivi

Zona: ***1*** **Locale:** ***2*** **Descrizione:** ***SOC01 - SOC storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***11,9***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***75,2***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,7***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	3	134	387	238	286	523
10	0	5	144	387	258	277	536
12	0	15	178	387	286	293	579
14	0	30	188	387	316	288	604
16	0	33	188	387	320	288	608
18	0	28	170	387	307	278	585

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	119	387
10	140	128	268	119	387
12	140	128	268	119	387
14	140	128	268	119	387
16	140	128	268	119	387
18	140	128	268	119	387

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	146	-12	134
10	8,3	0,4	137	7	144
12	9,2	1,5	153	25	178
14	8,9	2,4	148	40	188
16	8,9	2,4	148	40	188
18	8,3	1,9	138	32	170

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone

$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***3*** **Descrizione:** ***SOC02 - Security operation center***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***40,2***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***120,5***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,7***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***4,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***800***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*706*	*0*	*214*	*1738*	*2144*	*513*	*2658*
10	*895*	*14*	*231*	*1738*	*2377*	*500*	*2877*
12	*1014*	*82*	*285*	*1738*	*2593*	*525*	*3118*
14	*1097*	*158*	*301*	*1738*	*2777*	*517*	*3294*
16	*1151*	*176*	*301*	*1738*	*2850*	*517*	*3367*
18	*748*	*143*	*273*	*1738*	*2400*	*501*	*2901*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*280*	*256*	*536*	*402*	*1738*
10	*280*	*256*	*536*	*402*	*1738*
12	*280*	*256*	*536*	*402*	*1738*
14	*280*	*256*	*536*	*402*	*1738*
16	*280*	*256*	*536*	*402*	*1738*
18	*280*	*256*	*536*	*402*	*1738*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*233*	*-19*	*214*
10	*8,3*	*0,4*	*220*	*10*	*231*
12	*9,2*	*1,5*	*245*	*40*	*285*
14	*8,9*	*2,4*	*237*	*64*	*301*
16	*8,9*	*2,4*	*237*	*64*	*301*
18	*8,3*	*1,9*	*221*	*51*	*273*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***4*** **Descrizione:** ***SOC03 - SOC Manager Office***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***12,2***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***36,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***1,4***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***400***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*236*	*0*	*134*	*790*	*874*	*286*	*1160*
10	*299*	*5*	*145*	*790*	*960*	*278*	*1239*
12	*338*	*27*	*179*	*790*	*1041*	*294*	*1335*
14	*366*	*53*	*189*	*790*	*1110*	*289*	*1398*
16	*384*	*58*	*189*	*790*	*1134*	*289*	*1422*
18	*250*	*47*	*171*	*790*	*980*	*279*	*1258*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*140*	*128*	*268*	*122*	*790*
10	*140*	*128*	*268*	*122*	*790*
12	*140*	*128*	*268*	*122*	*790*
14	*140*	*128*	*268*	*122*	*790*
16	*140*	*128*	*268*	*122*	*790*
18	*140*	*128*	*268*	*122*	*790*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*146*	*-12*	*134*
10	*8,3*	*0,4*	*138*	*7*	*145*
12	*9,2*	*1,5*	*154*	*25*	*179*
14	*8,9*	*2,4*	*149*	*40*	*189*
16	*8,9*	*2,4*	*149*	*40*	*189*
18	*8,3*	*1,9*	*139*	*32*	*171*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***5*** **Descrizione:** ***BRK02 - Break Room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***30,6***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***91,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***2,4***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***16,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***500***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*172*	*0*	*592*	*2950*	*1949*	*1766*	*3714*
10	*218*	*4*	*638*	*2950*	*2080*	*1729*	*3810*
12	*247*	*20*	*787*	*2950*	*2207*	*1798*	*4005*
14	*268*	*47*	*834*	*2950*	*2323*	*1776*	*4098*
16	*281*	*60*	*834*	*2950*	*2349*	*1776*	*4125*
18	*182*	*51*	*754*	*2950*	*2205*	*1732*	*3937*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*1120*	*1024*	*2144*	*306*	*2950*
10	*1120*	*1024*	*2144*	*306*	*2950*
12	*1120*	*1024*	*2144*	*306*	*2950*
14	*1120*	*1024*	*2144*	*306*	*2950*
16	*1120*	*1024*	*2144*	*306*	*2950*
18	*1120*	*1024*	*2144*	*306*	*2950*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*646*	*-53*	*592*
10	*8,3*	*0,4*	*609*	*29*	*638*
12	*9,2*	*1,5*	*678*	*110*	*787*
14	*8,9*	*2,4*	*656*	*178*	*834*
16	*8,9*	*2,4*	*656*	*178*	*834*
18	*8,3*	*1,9*	*612*	*142*	*754*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***6*** **Descrizione:** ***LOB01 - Lobby***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***48,5***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***145,6***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,7***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***5,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***500***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*4072*	*4*	*270*	*1655*	*5357*	*644*	*6002*
10	*4377*	*12*	*291*	*1655*	*5707*	*628*	*6335*
12	*2910*	*68*	*359*	*1655*	*4333*	*659*	*4992*
14	*2008*	*143*	*380*	*1655*	*3538*	*649*	*4187*
16	*1545*	*165*	*380*	*1655*	*3097*	*649*	*3746*
18	*1117*	*136*	*344*	*1655*	*2623*	*629*	*3253*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*350*	*320*	*670*	*485*	*1655*
10	*350*	*320*	*670*	*485*	*1655*
12	*350*	*320*	*670*	*485*	*1655*
14	*350*	*320*	*670*	*485*	*1655*
16	*350*	*320*	*670*	*485*	*1655*
18	*350*	*320*	*670*	*485*	*1655*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*294*	*-24*	*270*
10	*8,3*	*0,4*	*278*	*13*	*291*
12	*9,2*	*1,5*	*309*	*50*	*359*
14	*8,9*	*2,4*	*299*	*81*	*380*
16	*8,9*	*2,4*	*299*	*81*	*380*
18	*8,3*	*1,9*	*279*	*65*	*344*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***7*** **Descrizione:** ***CON01 - Conference Room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***47,0***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***298,5***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,6***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***14,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***1000***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*4693*	*7*	*482*	*3346*	*7022*	*1505*	*8528*
10	*5044*	*21*	*519*	*3346*	*7454*	*1476*	*8930*
12	*3354*	*99*	*641*	*3346*	*5908*	*1531*	*7439*
14	*2314*	*192*	*678*	*3346*	*5017*	*1513*	*6530*
16	*1781*	*209*	*678*	*3346*	*4501*	*1513*	*6014*
18	*1287*	*172*	*614*	*3346*	*3941*	*1478*	*5418*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*980*	*896*	*1876*	*470*	*3346*
10	*980*	*896*	*1876*	*470*	*3346*
12	*980*	*896*	*1876*	*470*	*3346*
14	*980*	*896*	*1876*	*470*	*3346*
16	*980*	*896*	*1876*	*470*	*3346*
18	*980*	*896*	*1876*	*470*	*3346*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*525*	*-43*	*482*
10	*8,3*	*0,4*	*496*	*23*	*519*
12	*9,2*	*1,5*	*551*	*89*	*641*
14	*8,9*	*2,4*	*533*	*145*	*678*
16	*8,9*	*2,4*	*533*	*145*	*678*
18	*8,3*	*1,9*	*498*	*116*	*614*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***9*** **Descrizione:** ***SHP01 - Loading-unloading area***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***122,9***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***780,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,4***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***3,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***70***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***151***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	24	861	1892	1386	1391	2777
10	0	17	928	1892	1499	1339	2837
12	0	256	1145	1892	1854	1438	3293
14	0	382	1212	1892	2080	1406	3486
16	0	373	1212	1892	2071	1406	3477
18	0	263	1097	1892	1910	1342	3252

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	453	210	663	1229	1892
10	453	210	663	1229	1892
12	453	210	663	1229	1892
14	453	210	663	1229	1892
16	453	210	663	1229	1892
18	453	210	663	1229	1892

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	938	-78	861
10	8,3	0,4	886	42	928
12	9,2	1,5	985	159	1145
14	8,9	2,4	953	259	1212
16	8,9	2,4	953	259	1212
18	8,3	1,9	889	207	1097

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***10*** **Descrizione:** ***OFF01 - Asset managment office***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***9,8***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***29,5***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***1,7***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***400***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	0	135	766	614	287	901
10	0	0	145	766	633	279	912
12	0	0	179	766	651	294	946
14	0	20	190	766	687	289	976
16	0	20	190	766	687	289	976
18	0	0	172	766	659	279	938

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	98	766
10	140	128	268	98	766
12	140	128	268	98	766
14	140	128	268	98	766
16	140	128	268	98	766
18	140	128	268	98	766

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	147	-12	135
10	8,3	0,4	139	7	145
12	9,2	1,5	154	25	179
14	8,9	2,4	149	41	190
16	8,9	2,4	149	41	190
18	8,3	1,9	139	32	172

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***12*** **Descrizione:** ***STG01 - Staging-Receiving Area***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***64,6***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***410,0***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,4***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***3,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	2	485	1048	796	739	1535
10	0	0	523	1048	861	709	1571
12	0	0	645	1048	928	765	1693
14	0	4	683	1048	988	747	1735
16	0	27	683	1048	1010	747	1757
18	0	42	618	1048	997	711	1708

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	210	192	402	646	1048
10	210	192	402	646	1048
12	210	192	402	646	1048
14	210	192	402	646	1048
16	210	192	402	646	1048
18	210	192	402	646	1048

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	529	-44	485
10	8,3	0,4	499	24	523
12	9,2	1,5	555	90	645
14	8,9	2,4	537	146	683
16	8,9	2,4	537	146	683
18	8,3	1,9	501	117	618

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***14*** **Descrizione:** ***STO02- Storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***62,2***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***395,2***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	2	542	890	704	731	1435
10	0	0	584	890	777	698	1474
12	0	0	721	890	851	760	1611
14	0	3	763	890	916	740	1656
16	0	25	763	890	938	740	1678
18	0	42	690	890	923	700	1623

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	622	890
10	140	128	268	622	890
12	140	128	268	622	890
14	140	128	268	622	890
16	140	128	268	622	890
18	140	128	268	622	890

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	591	-49	542
10	8,3	0,4	558	26	584
12	9,2	1,5	620	100	721
14	8,9	2,4	600	163	763
16	8,9	2,4	600	163	763
18	8,3	1,9	560	130	690

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***22*** **Descrizione:** ***STO01 - Storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***41,6***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***264,0***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	0	376	684	510	550	1060
10	0	0	405	684	562	527	1089
12	0	0	500	684	613	571	1184
14	0	0	530	684	657	557	1214
16	0	0	530	684	657	557	1214
18	0	0	479	684	634	529	1163

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	416	684
10	140	128	268	416	684
12	140	128	268	416	684
14	140	128	268	416	684
16	140	128	268	416	684
18	140	128	268	416	684

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	410	-34	376
10	8,3	0,4	387	18	405
12	9,2	1,5	431	70	500
14	8,9	2,4	417	113	530
16	8,9	2,4	417	113	530
18	8,3	1,9	389	91	479

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***28*** **Descrizione:** ***BRK01 - Break Room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***22,9***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***145,2***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,7***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***5,000***	persone	Potenza elettrica per m^2	***20***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***500***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	0	269	1627	1253	644	1897
10	0	0	290	1627	1290	627	1917
12	0	0	358	1627	1327	658	1985
14	0	44	379	1627	1402	648	2050
16	0	54	379	1627	1412	648	2060
18	0	18	343	1627	1360	628	1988

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	350	320	670	457	1627
10	350	320	670	457	1627
12	350	320	670	457	1627
14	350	320	670	457	1627
16	350	320	670	457	1627
18	350	320	670	457	1627

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	294	-24	269
10	8,3	0,4	277	13	290
12	9,2	1,5	308	50	358
14	8,9	2,4	298	81	379
16	8,9	2,4	298	81	379
18	8,3	1,9	278	65	343

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***36*** **Descrizione:** ***STO12 - Storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***48,9***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***244,4***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	25	348	757	610	520	1130
10	0	5	375	757	639	498	1137
12	0	5	463	757	686	539	1225
14	0	38	491	757	760	526	1286
16	0	60	491	757	782	526	1308
18	0	91	444	757	792	500	1292

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	489	757
10	140	128	268	489	757
12	140	128	268	489	757
14	140	128	268	489	757
16	140	128	268	489	757
18	140	128	268	489	757

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	380	-31	348
10	8,3	0,4	358	17	375
12	9,2	1,5	399	64	463
14	8,9	2,4	386	105	491
16	8,9	2,4	386	105	491
18	8,3	1,9	360	84	444

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***37*** **Descrizione:** ***STO11 - Storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***53,8***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***268,9***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	44	26	376	806	702	550	1252
10	56	6	405	806	746	527	1273
12	64	10	500	806	809	570	1380
14	69	41	530	806	889	556	1446
16	72	56	530	806	908	556	1464
18	47	80	479	806	883	529	1412

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	538	806
10	140	128	268	538	806
12	140	128	268	538	806
14	140	128	268	538	806
16	140	128	268	538	806
18	140	128	268	538	806

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	410	-34	376
10	8,3	0,4	387	18	405
12	9,2	1,5	430	70	500
14	8,9	2,4	416	113	530
16	8,9	2,4	416	113	530
18	8,3	1,9	389	90	479

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***38*** **Descrizione:** ***OFF13 - Office***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***103,3***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***310,0***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,6***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***6,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***1200***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	8476	50	459	3038	11102	920	12022
10	9525	74	494	3038	12239	892	13130
12	7612	372	610	3038	10687	945	11632
14	6465	666	646	3038	9887	928	10815
16	5915	695	646	3038	9366	928	10293
18	4016	631	584	3038	7375	894	8269

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	420	384	804	1034	3038
10	420	384	804	1034	3038
12	420	384	804	1034	3038
14	420	384	804	1034	3038
16	420	384	804	1034	3038
18	420	384	804	1034	3038

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	500	-41	459
10	8,3	0,4	472	22	494
12	9,2	1,5	525	85	610
14	8,9	2,4	508	138	646
16	8,9	2,4	508	138	646
18	8,3	1,9	474	110	584

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***39*** **Descrizione:** ***OFF12 - Office***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***119,6***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***358,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***6,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***1200***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*11008*	*56*	*511*	*3200*	*13797*	*977*	*14775*
10	*11831*	*44*	*551*	*3200*	*14680*	*946*	*15626*
12	*7867*	*197*	*680*	*3200*	*10938*	*1005*	*11944*
14	*5428*	*403*	*720*	*3200*	*8764*	*986*	*9750*
16	*4177*	*435*	*720*	*3200*	*7547*	*986*	*8533*
18	*3019*	*410*	*651*	*3200*	*6331*	*948*	*7279*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*420*	*384*	*804*	*1196*	*3200*
10	*420*	*384*	*804*	*1196*	*3200*
12	*420*	*384*	*804*	*1196*	*3200*
14	*420*	*384*	*804*	*1196*	*3200*
16	*420*	*384*	*804*	*1196*	*3200*
18	*420*	*384*	*804*	*1196*	*3200*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*8,8*	*-0,7*	*557*	*-46*	*511*
10	*8,3*	*0,4*	*526*	*25*	*551*
12	*9,2*	*1,5*	*585*	*95*	*680*
14	*8,9*	*2,4*	*566*	*154*	*720*
16	*8,9*	*2,4*	*566*	*154*	*720*
18	*8,3*	*1,9*	*528*	*123*	*651*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***40*** **Descrizione:** ***OFF11 - Office***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***215,6***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***646,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***1,0***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***11,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***2200***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	11854	101	1739	5830	16858	2666	19524
10	16771	96	1874	5830	22011	2559	24571
12	16755	448	2313	5830	22584	2761	25345
14	15906	847	2449	5830	22337	2695	25032
16	12925	910	2449	5830	19418	2695	22114
18	8100	876	2216	5830	14454	2567	17021

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	770	704	1474	2156	5830
10	770	704	1474	2156	5830
12	770	704	1474	2156	5830
14	770	704	1474	2156	5830
16	770	704	1474	2156	5830
18	770	704	1474	2156	5830

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	1896	-157	1739
10	8,3	0,4	1789	85	1874
12	9,2	1,5	1991	322	2313
14	8,9	2,4	1925	524	2449
16	8,9	2,4	1925	524	2449
18	8,3	1,9	1797	419	2216

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***1*** **Locale:** ***41*** **Descrizione:** ***STO13 - Storage***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***26,0***	°C	Superficie utile	***144,0***	m^2
Temperatura bulbo umido	***18,6***	°C	Volume netto	***734,2***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h
Efficienza recupero sensibile:	***0,67***				
Efficienza recupero latente:	***0,26***				

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***10***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	104	987	1708	1583	1216	2799
10	0	50	1064	1708	1665	1156	2821
12	0	49	1313	1708	1799	1270	3069
14	0	118	1390	1708	1983	1233	3216
16	0	187	1390	1708	2052	1233	3285
18	0	307	1258	1708	2113	1160	3273

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	1440	1708
10	140	128	268	1440	1708
12	140	128	268	1440	1708
14	140	128	268	1440	1708
16	140	128	268	1440	1708
18	140	128	268	1440	1708

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	8,8	-0,7	1076	-89	987
10	8,3	0,4	1016	48	1064
12	9,2	1,5	1130	183	1313
14	8,9	2,4	1093	297	1390
16	8,9	2,4	1093	297	1390
18	8,3	1,9	1020	238	1258

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***1*** **Descrizione:** ***SH01 - Data Hall***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***27,0***	°C	Superficie utile	***1936,4***	m^2
Temperatura bulbo umido	***19,4***	°C	Volume netto	***8520,1***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,2***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***58***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***76***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	582	3246	268	-802	4897	4095
10	0	0	4305	268	-12	4586	4573
12	0	0	6231	268	1318	5181	6499
14	0	478	7170	268	2939	4977	7916
16	0	981	7170	268	3442	4977	8418
18	0	2138	6233	268	4012	4627	8640

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	152	116	268	0	268
10	152	116	268	0	268
12	152	116	268	0	268
14	152	116	268	0	268
16	152	116	268	0	268
18	152	116	268	0	268

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	9,8	-3,1	4745	-1500	3246
10	9,2	-0,3	4434	-128	4305
12	10,4	2,5	5029	1202	6231
14	10,0	4,9	4825	2345	7170
16	10,0	4,9	4825	2345	7170
18	9,3	3,6	4475	1758	6233

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***2*** **Descrizione:** ***MMR02- MMR/POE***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***29,5***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***186,0***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*0*	*19*	*394*	*268*	*114*	*566*	*681*
10	*0*	*8*	*466*	*268*	*196*	*545*	*741*
12	*0*	*8*	*597*	*268*	*287*	*586*	*872*
14	*0*	*193*	*661*	*268*	*550*	*572*	*1122*
16	*0*	*201*	*661*	*268*	*559*	*572*	*1130*
18	*0*	*87*	*597*	*268*	*405*	*548*	*952*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*140*	*128*	*268*	*0*	*268*
10	*140*	*128*	*268*	*0*	*268*
12	*140*	*128*	*268*	*0*	*268*
14	*140*	*128*	*268*	*0*	*268*
16	*140*	*128*	*268*	*0*	*268*
18	*140*	*128*	*268*	*0*	*268*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*13,0*	*-1,0*	*426*	*-33*	*394*
10	*12,3*	*1,8*	*405*	*61*	*466*
12	*13,6*	*4,6*	*446*	*151*	*597*
14	*13,1*	*7,0*	*432*	*229*	*661*
16	*13,1*	*7,0*	*432*	*229*	*661*
18	*12,4*	*5,8*	*408*	*189*	*597*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***23*** **Descrizione:** ***ER01 - Electrical room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***20,3***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***127,8***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,6***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*0*	*36*	*286*	*268*	*140*	*449*	*589*
10	*0*	*36*	*338*	*268*	*208*	*434*	*642*
12	*0*	*36*	*433*	*268*	*274*	*463*	*737*
14	*0*	*105*	*479*	*268*	*400*	*453*	*853*
16	*0*	*105*	*479*	*268*	*400*	*453*	*853*
18	*0*	*54*	*433*	*268*	*319*	*436*	*755*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*140*	*128*	*268*	*0*	*268*
10	*140*	*128*	*268*	*0*	*268*
12	*140*	*128*	*268*	*0*	*268*
14	*140*	*128*	*268*	*0*	*268*
16	*140*	*128*	*268*	*0*	*268*
18	*140*	*128*	*268*	*0*	*268*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*13,0*	*-1,0*	*309*	*-24*	*286*
10	*12,3*	*1,8*	*294*	*44*	*338*
12	*13,6*	*4,6*	*323*	*110*	*433*
14	*13,1*	*7,0*	*313*	*166*	*479*
16	*13,1*	*7,0*	*313*	*166*	*479*
18	*12,4*	*5,8*	*296*	*137*	*433*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***24*** **Descrizione:** ***ER02 - Electrical Room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***22,0***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***139,1***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*0*	*38*	*278*	*268*	*143*	*441*	*584*
10	*0*	*38*	*329*	*268*	*209*	*426*	*634*
12	*0*	*38*	*421*	*268*	*273*	*454*	*727*
14	*0*	*38*	*466*	*268*	*327*	*445*	*772*
16	*0*	*38*	*466*	*268*	*327*	*445*	*772*
18	*0*	*39*	*421*	*268*	*301*	*428*	*729*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*140*	*128*	*268*	*0*	*268*
10	*140*	*128*	*268*	*0*	*268*
12	*140*	*128*	*268*	*0*	*268*
14	*140*	*128*	*268*	*0*	*268*
16	*140*	*128*	*268*	*0*	*268*
18	*140*	*128*	*268*	*0*	*268*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*13,0*	*-1,0*	*301*	*-23*	*278*
10	*12,3*	*1,8*	*286*	*43*	*329*
12	*13,6*	*4,6*	*314*	*107*	*421*
14	*13,1*	*7,0*	*305*	*162*	*466*
16	*13,1*	*7,0*	*305*	*162*	*466*
18	*12,4*	*5,8*	*288*	*133*	*421*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***25*** **Descrizione:** ***CER01 - Comunication equipment room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***35,6***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***224,6***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***58***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***76***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	61	484	268	137	676	813
10	0	61	573	268	251	650	902
12	0	61	734	268	363	700	1063
14	0	118	813	268	516	683	1199
16	0	118	813	268	516	683	1199
18	0	76	734	268	425	654	1078

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	152	116	268	0	268
10	152	116	268	0	268
12	152	116	268	0	268
14	152	116	268	0	268
16	152	116	268	0	268
18	152	116	268	0	268

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	13,0	-1,0	524	-40	484
10	12,3	1,8	498	75	573
12	13,6	4,6	548	186	734
14	13,1	7,0	531	282	813
16	13,1	7,0	531	282	813
18	12,4	5,8	502	233	734

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***26*** **Descrizione:** ***MMR01 - MMR / POE***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***27,0***	°C	Superficie utile	***36,3***	m^2
Temperatura bulbo umido	***19,4***	°C	Volume netto	***229,4***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	1	267	268	5	531	536
10	0	0	355	268	117	505	623
12	0	9	513	268	236	554	790
14	0	12	590	268	333	537	871
16	0	33	590	268	355	537	892
18	0	53	513	268	326	509	835

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	140	128	268	0	268
10	140	128	268	0	268
12	140	128	268	0	268
14	140	128	268	0	268
16	140	128	268	0	268
18	140	128	268	0	268

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	9,8	-3,1	391	-123	267
10	9,2	-0,3	365	-11	355
12	10,4	2,5	414	99	513
14	10,0	4,9	397	193	590
16	10,0	4,9	397	193	590
18	9,3	3,6	369	145	513

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***29*** **Descrizione:** ***CER02 - Comunications Equipments Room***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***23,7***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***149,4***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,5***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***58***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***76***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	15	298	268	106	475	581
10	0	6	353	268	168	459	627
12	0	6	452	268	237	490	726
14	0	123	501	268	413	479	892
16	0	130	501	268	420	479	899
18	0	62	452	268	322	461	783

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	152	116	268	0	268
10	152	116	268	0	268
12	152	116	268	0	268
14	152	116	268	0	268
16	152	116	268	0	268
18	152	116	268	0	268

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	13,0	-1,0	323	-25	298
10	12,3	1,8	307	46	353
12	13,6	4,6	338	115	452
14	13,1	7,0	327	174	501
16	13,1	7,0	327	174	501
18	12,4	5,8	309	143	452

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***30*** **Descrizione:** ***DH02 - Data Hall***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***27,0***	°C	Superficie utile	***1917,1***	m^2
Temperatura bulbo umido	***19,4***	°C	Volume netto	***8435,3***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***0,2***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***58***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***76***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	0	576	3213	268	-793	4850	4057
10	0	0	4263	268	-11	4542	4531
12	0	0	6169	268	1306	5131	6437
14	0	473	7098	268	2911	4929	7840
16	0	971	7098	268	3408	4929	8337
18	0	2117	6171	268	3973	4583	8556

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	152	116	268	0	268
10	152	116	268	0	268
12	152	116	268	0	268
14	152	116	268	0	268
16	152	116	268	0	268
18	152	116	268	0	268

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	9,8	-3,1	4698	-1485	3213
10	9,2	-0,3	4390	-127	4263
12	10,4	2,5	4979	1190	6169
14	10,0	4,9	4777	2322	7098
16	10,0	4,9	4777	2322	7098
18	9,3	3,6	4431	1740	6171

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

Zona: ***2*** **Locale:** ***31*** **Descrizione:** ***IDF01 - IDF***

Scambi termici per irraggiamento, trasmissione e ventilazione:

Temperatura bulbo secco	***25,0***	°C	Superficie utile	***6,7***	m^2
Temperatura bulbo umido	***17,8***	°C	Volume netto	***40,7***	m^3
Umidità relativa interna	***50,0***	%	Ricambio di picco	***1,2***	vol/h

Carichi interni:

Numero di persone	***2,000***	persone	Potenza elettrica per m^2	***0***	W/m^2
Q sensibile per persona	***64***	W/pers	Altro Q sensibile	***0***	W
Q latente per persona	***70***	W/pers	Altro Q latente	***0***	W

Mese: ***Luglio***

Carichi termici complessivi:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	*0*	*11*	*200*	*268*	*122*	*356*	*478*
10	*0*	*5*	*236*	*268*	*164*	*346*	*509*
12	*0*	*5*	*303*	*268*	*210*	*366*	*576*
14	*0*	*72*	*335*	*268*	*316*	*359*	*675*
16	*0*	*80*	*335*	*268*	*324*	*359*	*684*
18	*0*	*55*	*303*	*268*	*279*	*347*	*626*

Dettaglio dei carichi termici interni:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	Q_{pers} [W]	$Q_{sen,elett}$ [W]	Q_c [W]
8	*140*	*128*	*268*	*0*	*268*
10	*140*	*128*	*268*	*0*	*268*
12	*140*	*128*	*268*	*0*	*268*
14	*140*	*128*	*268*	*0*	*268*
16	*140*	*128*	*268*	*0*	*268*
18	*140*	*128*	*268*	*0*	*268*

Dettaglio dei carichi termici per ventilazione:

Ora	$Dh_{,lat}$ [kJ/kg]	$Dh_{,sen}$ [kJ/kg]	$Q_{v,lat}$ [W]	$Q_{v,sen}$ [W]	Q_v [W]
8	*13,0*	*-1,0*	*216*	*-17*	*200*
10	*12,3*	*1,8*	*206*	*31*	*236*
12	*13,6*	*4,6*	*226*	*77*	*303*
14	*13,1*	*7,0*	*219*	*116*	*335*
16	*13,1*	*7,0*	*219*	*116*	*335*
18	*12,4*	*5,8*	*207*	*96*	*303*

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Dh_{lat}	Differenza di entalpia latente per l'aria di rinnovo
Dh_{sen}	Differenza di entalpia sensibile per l'aria di rinnovo
$Q_{v,lat}$	Carico latente dovuto alla ventilazione
$Q_{v,sen}$	Carico sensibile dovuto alla ventilazione
$Q_{lat,pers}$	Carico latente dovuto alla presenza di persone
$Q_{sen,pers}$	Carico sensibile dovuto alla presenza di persone
$Q_{sen,elett}$	Carico sensibile dovuto alla presenza di macchinari elettrici

CARICHI TERMICI INTERO EDIFICIO

Edificio : MIL07 Data Center

Mese: ***Luglio***

Ora di massimo carico dell'edificio: ***10***

Volume netto totale climatizzato	***23408,31***	m^3
Superficie netta totale climatizzata	***5227,18***	m^2
Coefficiente di contemporaneità per persone	***1,00***	-
Coefficiente di contemporaneità per carichi elettrici	***1,00***	-
Numero totale di persone	***107,00***	-
Numero totale di persone con coefficiente contemporaneità	***107,00***	-
Potenza elettrica totale	***12223,80***	W
Potenza elettrica totale con coefficiente di contemporaneità	***12223,80***	W
Totale altro calore sensibile	***8700***	W
Totale altro calore latente	***0***	W

Carichi termici senza riduzione per contemporaneità:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	41260	1742	17581	35523	66671	29434	96106
10	49016	506	20824	35523	77731	28138	105868
12	40161	1809	27708	35523	74597	30604	105201
14	33920	4803	30667	35523	75137	29775	104912
16	28232	6203	30667	35523	70849	29775	100625
18	18764	8021	27216	35523	61247	28277	89524

Dettaglio carichi interni Qc:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	$Q_{sen,elett}$ [W]	Altro Q_{lat} [W]	Altro Q_{sen} [W]	Q_c [W]
8	7781	6818	12224	0	8700	35523
10	7781	6818	12224	0	8700	35523
12	7781	6818	12224	0	8700	35523
14	7781	6818	12224	0	8700	35523
16	7781	6818	12224	0	8700	35523
18	7781	6818	12224	0	8700	35523

Carichi termici con riduzione per contemporaneità:

Ora	Q_{Irr} [W]	Q_{Tr} [W]	Q_v [W]	Q_c [W]	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
8	41260	1742	17581	35523	66671	29434	96106
10	49016	506	20824	35523	77731	28138	105868
12	40161	1809	27708	35523	74597	30604	105201
14	33920	4803	30667	35523	75137	29775	104912
16	28232	6203	30667	35523	70849	29775	100625
18	18764	8021	27216	35523	61247	28277	89524

Dettaglio carichi interni Qc:

Ora	$Q_{lat,pers}$ [W]	$Q_{sen,pers}$ [W]	$Q_{sen,elett}$ [W]	Altro Q_{lat} [W]	Altro Q_{sen} [W]	Q_c [W]
8	7781	6818	12224	0	8700	35523
10	7781	6818	12224	0	8700	35523
12	7781	6818	12224	0	8700	35523
14	7781	6818	12224	0	8700	35523
16	7781	6818	12224	0	8700	35523
18	7781	6818	12224	0	8700	35523

Legenda simboli

Q_{Irr}	Carico dovuto all'irraggiamento
Q_{Tr}	Carico dovuto alla trasmissione
Q_v	Carico dovuto alla ventilazione
Q_c	Carichi interni
$Q_{lat,pers}$	Carichi interni latenti per persone
$Q_{sen,pers}$	Carichi interni sensibili per persone
$Q_{sen,elett}$	Carichi interni elettrici
Altro Q_{lat}	Altri carichi interni latenti
Altro Q_{sen}	Altri carichi interni sensibili
$Q_{gl,sen}$	Carico sensibile globale
$Q_{gl,lat}$	Carico latente globale
Q_{gl}	Carico globale

Elenco potenze massime estive dei singoli locali

Zona	Locale	Descrizione	Mese	Ora	$Q_{gl,sen}$ [W]	$Q_{gl,lat}$ [W]	Q_{gl} [W]
1	2	SOC01 - SOC storage	luglio	16	320	288	608
1	3	SOC02 - Security operation center	luglio	16	2850	517	3367
1	4	SOC03 - SOC Manager Office	luglio	16	1134	289	1422
1	5	BRK02 - Break Room	luglio	16	2349	1776	4125
1	6	LOB01 - Lobby	luglio	10	5707	628	6335
1	7	CON01 - Conference Room	luglio	10	7454	1476	8930
1	9	SHP01 - Loading-unloading area	luglio	14	2080	1406	3486
1	10	OFF01 - Asset managment office	luglio	14	687	289	976
1	12	STG01 - Staging-Receiving Area	luglio	16	1010	747	1757
1	14	STO02- Storage	luglio	16	938	740	1678
1	22	STO01 - Storage	luglio	14	657	557	1214
1	28	BRK01 - Break Room	luglio	16	1412	648	2060
1	36	STO12 - Storage	luglio	16	782	526	1308
1	37	STO11 - Storage	luglio	16	908	556	1464
1	38	OFF13 - Office	luglio	10	12239	892	13130
1	39	OFF12 - Office	luglio	10	14680	946	15626
1	40	OFF11 - Office	luglio	12	22584	2761	25345
1	41	STO13 - Storage	luglio	16	2052	1233	3285
2	1	SH01 - Data Hall	luglio	18	4012	4627	8640
2	2	MMR02- MMR/POE	luglio	16	559	572	1130
2	23	ER01 - Electrical room	luglio	14	400	453	853
2	24	ER02 - Electrical Room	luglio	14	327	445	772
2	25	CER01 - Comunication equipment room	luglio	14	516	683	1199
2	26	MMR01 - MMR / POE	luglio	16	355	537	892
2	29	CER02 - Comunications Equipments Room	luglio	16	420	479	899
2	30	DH02 - Data Hall	luglio	18	3973	4583	8556
2	31	IDF01 - IDF	luglio	16	324	359	684

Legenda simboli

$Q_{gl,sen}$ Carico sensibile globale

$Q_{gl,lat}$ Carico latente globale

Q_{gl} Carico globale

MIL07

Via Lombardia 1, Siziano, MI, Italy

STACK INFRASTRUCTURE

Report – Energy Assessment – Data Center Office Area

MIL07-DBA-AF-XX-RP-M-50010

07/11/2025

Status – S4/P01

Project Number: 13038001

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Approved by:	Sacha Busetti

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REV.	EDITED	CHECKED	APP.	DATE	DESCRIPTION
P01	LG	GR	SB	07/11/2025	RIBA 3 - Work Stage 3 (WS3)

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Relazione tecnica di calcolo
prestazione energetica del sistema edificio-impianto

EDIFICIO	***MIL07 Data Center***
INDIRIZZO	
COMMITTENTE	***Stack Data Center***
INDIRIZZO	
COMUNE	***Siziano***

Rif. ***MIL07-DBA-AF-XX-RP-M-50010 - Report - Energy Assessment - Data Center Office Area.E0001***

Software di calcolo EDILCLIMA – EC700 versione 13.25.9

DBA PRO. S.P.A.
VIALE FELISSENT, 20/D - 31020 VILLORBA (TV)

DATI PROGETTO ED IMPOSTAZIONI DI CALCOLO

Dati generali

Destinazione d'uso prevalente (DPR 412/93)	***E.2 Edifici adibiti a uffici e assimilabili.***
Edificio pubblico o ad uso pubblico	***No***
Edificio situato in un centro storico	***No***
Tipologia di calcolo	***Calcolo regolamentare (valutazione A1/A2)***

Opzioni lavoro

Ponti termici	***Calcolo analitico***
Resistenze liminari	***Appendice A UNI EN ISO 6946***
Serre / locali non climatizzati	***Calcolo analitico***
Capacità termica	***Calcolo semplificato***
Ombreggiamenti	***Calcolo manuale***
Radiazione solare	***Calcolo con angolo di Azimut***

Opzioni di calcolo

Regime normativo	***UNI/TS 11300-4 e 5:2016***
Rendimento globale medio stagionale	***FAQ ministeriali (agosto 2016)***
Verifica di condensa interstiziale	***UNI EN ISO 13788***

DATI CLIMATICI DELLA LOCALITÀ

Caratteristiche geografiche

Località		***Siziano***		
Provincia		***Pavia***		
Altitudine s.l.m.			***93***	m
Latitudine nord	***45° 18'***	Longitudine est	***9° 12'***	
Gradi giorno DPR 412/93			***2601***	
Zona climatica			***E***	

Località di riferimento

per dati invernali	***Pavia***
per dati estivi	***Pavia***

Stazioni di rilevazione

per la temperatura	***S.Angelo Lodigiano***
per l'irradiazione	***S.Angelo Lodigiano***
per il vento	***S.Angelo Lodigiano***

Caratteristiche del vento

Regione di vento:	***A***	
Direzione prevalente	***Sud-Ovest***	
Distanza dal mare	***> 40***	km
Velocità media del vento	***0,7***	m/s
Velocità massima del vento	***1,4***	m/s

Dati invernali

Temperatura esterna di progetto	***-5,1***	°C
Stagione di riscaldamento convenzionale	dal ***15 ottobre*** al ***15 aprile***	

Dati estivi

Temperatura esterna bulbo asciutto	***32,0***	°C
Temperatura esterna bulbo umido	***23,6***	°C
Umidità relativa	***50,0***	%
Escursione termica giornaliera	***12***	°C

Temperature esterne medie mensili

Descrizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Temperatura	°C	*1,4*	*4,5*	*9,4*	*12,6*	*18,4*	*22,4*	*24,1*	*22,6*	*17,8*	*14,1*	*6,4*	*1,5*

Irradiazione solare media mensile

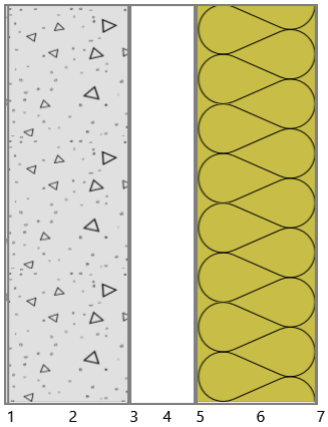
Esposizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Nord	MJ/m²	*1,6*	*2,4*	*3,7*	*5,3*	*8,4*	*10,2*	*9,7*	*6,8*	*4,5*	*2,8*	*1,8*	*1,3*
Nord-Est	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Est	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Sud-Est	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Sud	MJ/m²	*10,1*	*11,2*	*13,4*	*10,6*	*10,5*	*10,6*	*11,1*	*11,3*	*12,6*	*8,7*	*10,7*	*7,6*
Sud-Ovest	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Ovest	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Nord-Ovest	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Orizz. Diffusa	MJ/m²	*2,1*	*3,2*	*4,7*	*6,6*	*9,5*	*9,6*	*9,0*	*7,5*	*5,7*	*4,1*	*2,5*	*1,9*
Orizz. Diretta	MJ/m²	*2,9*	*4,6*	*8,6*	*9,5*	*11,1*	*14,1*	*15,1*	*12,2*	*9,8*	*3,8*	*3,5*	*1,9*

Irradianza sul piano orizzontale nel mese di massima insolazione: ***279*** W/m²

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV1 - Parete vs esterno (con cls)*** **Codice:** ***M1***

Trasmittanza termica	***0,169***	W/m²K
Spessore	***389***	mm
Temperatura esterna (calcolo potenza invernale)	***-5,1***	°C
Permeanza	***0,003***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***192***	kg/m²
Massa superficiale (senza intonaci)	***183***	kg/m²
Trasmittanza periodica	***0,020***	W/m²K
Fattore attenuazione	***0,118***	-
Sfasamento onda termica	***-14,2***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	Malta di calce o di calce e cemento	5,00	0,9000	0,006	1800	1,00	22
2	C.l.s. espanso in fabbrica (pareti int.)	150,00	0,1296	0,556	800	1,00	7
3	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
4	Intercapedine non ventilata Av<500 mm²/m	80,00	0,4444	0,180	-	-	-
5	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
6	Pannello in lana di roccia - standard (coperture inclinate)	148,00	0,0340	4,353	110	1,03	1
7	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
-	Resistenza superficiale esterna	-	-	0,089	-	-	-

Coefficienti correttivi della conduttività dei materiali:

N.	Descrizione strato	Cond.	c	Cond/c
1	Malta di calce o di calce e cemento	0,9000	1,00	0,9000
2	C.l.s. espanso in fabbrica (pareti int.)	0,1296	0,48	0,2700
3	Acciaio	52,0000	1,00	52,0000
4	Intercapedine non ventilata Av<500 mm²/m	0,4444	1,00	0,4444
5	Acciaio	52,0000	1,00	52,0000
6	Pannello in lana di roccia - standard (coperture inclinate)	0,0340	1,00	0,0340
7	Acciaio	52,0000	1,00	52,0000

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m²K/W
M.V.	Massa volumica	kg/m³
C.T.	Capacità termica specifica	kJ/kgK

R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-
c	Coefficiente correttivo della conduttività termica	-
Cond/c	Conduttività termica, in assenza di coefficienti correttivi	W/mK

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV1 - Parete vs esterno (con cls)*** **Codice:** ***M1***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[] La struttura non è soggetta a fenomeni di condensa interstiziale.

[*x*] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,651***	
Fattore di temperatura del componente	f_{RSI}	***0,958***	
Umidità relativa superficiale accettabile		***80***	%

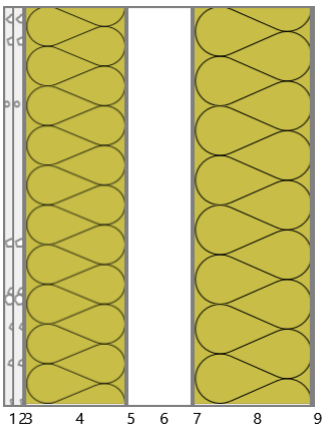
Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Verifica condensa interstiziale		***Positiva***	
Quantità massima di condensa durante l'anno	M_a	***0***	g/m²
Quantità di condensa ammissibile	M_{lim}	***100***	g/m²
Verifica di condensa ammissibile ($M_a \leq M_{lim}$)		***Positiva***	
Mese con massima condensa accumulata		***febbraio***	
L'evaporazione a fine stagione è		***Completa***	

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV2 - Parete vs esterno (con controparete)*** **Codice:** ***M2***

Trasmittanza termica	***0,117***	W/m²K
Spessore	***384***	mm
Temperatura esterna (calcolo potenza invernale)	***-5,1***	°C
Permeanza	***0,003***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***86***	kg/m²
Massa superficiale (senza intonaci)	***68***	kg/m²
Trasmittanza periodica	***0,028***	W/m²K
Fattore attenuazione	***0,242***	-
Sfasamento onda termica	***-10,2***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
2	Cartongesso in lastre	12,50	0,1008	0,060	700	1,00	10
3	INTELLO; Freno al vapore Hydrosafe® ad alte prestazioni per coibenti fibrosi in stuoia o pannello	0,25	0,0400	0,006	340	1,00	30000
4	Pannello in lana di roccia	125,00	0,0350	3,571	40	1,03	1
5	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
6	Intercapedine non ventilata Av<500 mm²/m	80,00	0,4444	0,180	-	-	-
7	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
8	Pannello in lana di roccia - standard (coperture inclinate)	148,00	0,0340	4,353	110	1,03	1
9	Acciaio	2,00	52,0000	0,000	7800	0,45	9999999
-	Resistenza superficiale esterna	-	-	0,089	-	-	-

Coefficienti correttivi della conduttività dei materiali:

N.	Descrizione strato	Cond.	c	Cond/c
1	Cartongesso in lastre	0,2100	1,00	0,2100
2	Cartongesso in lastre	0,1008	0,48	0,2100
3	INTELLO; Freno al vapore Hydrosafe® ad alte prestazioni per coibenti fibrosi in stuoia o pannello	0,0400	1,00	0,0400
4	Pannello in lana di roccia	0,0350	1,00	0,0350
5	Acciaio	52,0000	1,00	52,0000
6	Intercapedine non ventilata Av<500 mm²/m	0,4444	1,00	0,4444
7	Acciaio	52,0000	1,00	52,0000
8	Pannello in lana di roccia - standard (coperture inclinate)	0,0340	1,00	0,0340
9	Acciaio	52,0000	1,00	52,0000

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m^2K/W
M.V.	Massa volumica	kg/m^3
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-
c	Coefficiente correttivo della conduttività termica	-
Cond/c	Conduttività termica, in assenza di coefficienti correttivi	W/mK

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV2 - Parete vs esterno (con controparete)*** **Codice:** ***M2***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[] La struttura non è soggetta a fenomeni di condensa interstiziale.

[*x*] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,651***	
Fattore di temperatura del componente	f_{RSI}	***0,971***	
Umidità relativa superficiale accettabile		***80***	%

Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

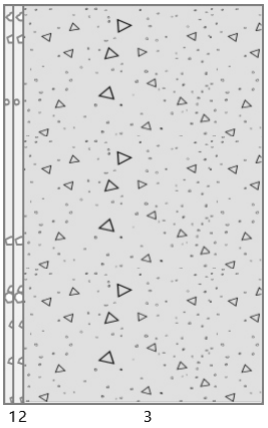
Verifica condensa interstiziale		***Positiva***	
Quantità massima di condensa durante l'anno	M_a	***0***	g/m²
Quantità di condensa ammissibile	M_{lim}	***100***	g/m²
Verifica di condensa ammissibile ($M_a \leq M_{lim}$)		***Positiva***	
Mese con massima condensa accumulata		***febbraio***	
L'evaporazione a fine stagione è		***Completa***	

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV21: vs non climatizzato (vs scala - semplificato - 1 parete esterna)***

Codice: ***M21***

Trasmittanza termica	***2,004***	W/m²K
Spessore	***325***	mm
Temperatura esterna (calcolo potenza invernale)	***10,0***	°C
Permeanza	***5,096***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***738***	kg/m²
Massa superficiale (senza intonaci)	***720***	kg/m²
Trasmittanza periodica	***0,330***	W/m²K
Fattore attenuazione	***0,165***	-
Sfasamento onda termica	***-8,8***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
2	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
3	C.l.s. armato (2% acciaio)	300,00	2,5000	0,120	2400	1,00	130
-	Resistenza superficiale esterna	-	-	0,130	-	-	-

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m²K/W
M.V.	Massa volumica	kg/m³
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV21: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*** **Codice:** ***M21***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[*x*] La struttura non è soggetta a fenomeni di condensa interstiziale.

[] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,128***	
Fattore di temperatura del componente	f_{RSI}	***0,662***	
Umidità relativa superficiale accettabile		***80***	%

Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

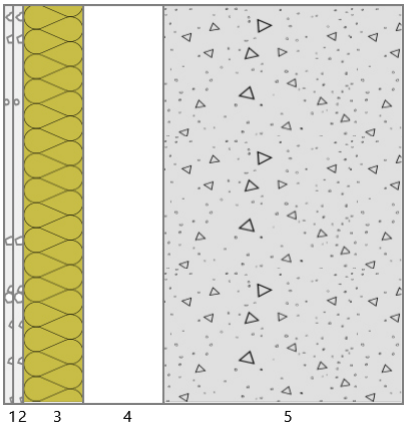
Non si verifica formazione di condensa interstiziale nella struttura durante tutto l'arco dell'anno.

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV22: vs non climatizzato (vs scala con controparete - 1 parete esterna)***

Codice: ***M22***

Trasmittanza termica	***0,354***	W/m²K
Spessore	***500***	mm
Temperatura esterna (calcolo potenza invernale)	***10,0***	°C
Permeanza	***5,085***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***741***	kg/m²
Massa superficiale (senza intonaci)	***723***	kg/m²
Trasmittanza periodica	***0,036***	W/m²K
Fattore attenuazione	***0,101***	-
Sfasamento onda termica	***-10,2***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
2	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
3	Pannello in lana di roccia	75,00	0,0350	2,143	40	1,03	1
4	Intercapedine non ventilata Av<500 mm²/m	100,00	0,5556	0,180	-	-	-
5	C.l.s. armato (2% acciaio)	300,00	2,5000	0,120	2400	1,00	130
-	Resistenza superficiale esterna	-	-	0,130	-	-	-

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m²K/W
M.V.	Massa volumica	kg/m³
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV22: vs non climatizzato (vs scala con controparete - 1 parete esterna)*** **Codice:** ***M22***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[*x*] La struttura non è soggetta a fenomeni di condensa interstiziale.

[] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,128***	
Fattore di temperatura del componente	f_{RSI}	***0,918***	
Umidità relativa superficiale accettabile		***80***	%

Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

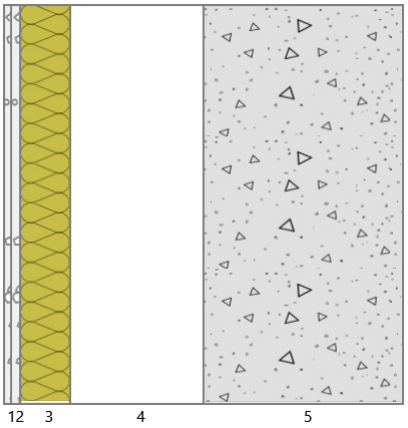
Non si verifica formazione di condensa interstiziale nella struttura durante tutto l'arco dell'anno.

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV23: vs non climatizzato (vs scala con controparete - 1 parete esterna)***

Codice: ***M23***

Trasmittanza termica	***0,354***	W/m²K
Spessore	***600***	mm
Temperatura esterna (calcolo potenza invernale)	***10,0***	°C
Permeanza	***5,085***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***741***	kg/m²
Massa superficiale (senza intonaci)	***723***	kg/m²
Trasmittanza periodica	***0,036***	W/m²K
Fattore attenuazione	***0,101***	-
Sfasamento onda termica	***-10,2***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
2	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
3	Pannello in lana di roccia	75,00	0,0350	2,143	40	1,03	1
4	Intercapedine non ventilata Av<500 mm²/m	200,00	1,1111	0,180	-	-	-
5	C.l.s. armato (2% acciaio)	300,00	2,5000	0,120	2400	1,00	130
-	Resistenza superficiale esterna	-	-	0,130	-	-	-

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m²K/W
M.V.	Massa volumica	kg/m³
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV23: vs non climatizzato (vs scala con controparete - 1 parete esterna)*** **Codice:** ***M23***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[*x*] La struttura non è soggetta a fenomeni di condensa interstiziale.

[] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,128***	
Fattore di temperatura del componente	f_{RSI}	***0,918***	
Umidità relativa superficiale accettabile		***80***	%

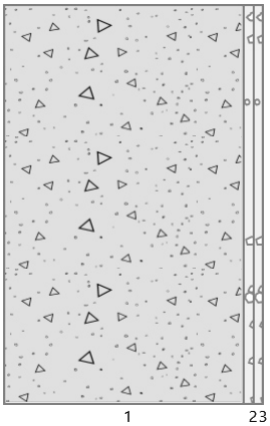
Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Non si verifica formazione di condensa interstiziale nella struttura durante tutto l'arco dell'anno.

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CV24: vs non climatizzato (vs scala - 15°C)*** **Codice:** ***M24***

Trasmittanza termica	***2,004***	W/m^2K
Spessore	***325***	mm
Temperatura esterna (calcolo potenza invernale)	***15,0***	°C
Permeanza	***5,096***	$10^{-12}kg/sm^2Pa$
Massa superficiale (con intonaci)	***738***	kg/m^2
Massa superficiale (senza intonaci)	***720***	kg/m^2
Trasmittanza periodica	***0,330***	W/m^2K
Fattore attenuazione	***0,165***	-
Sfasamento onda termica	***-8,8***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,130	-	-	-
1	C.l.s. armato (2% acciaio)	300,00	2,5000	0,120	2400	1,00	130
2	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
3	Cartongesso in lastre	12,50	0,2100	0,060	700	1,00	10
-	Resistenza superficiale esterna	-	-	0,130	-	-	-

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m^2K/W
M.V.	Massa volumica	kg/m^3
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CV24: vs non climatizzato (vs scala - 15°C)*** **Codice:** ***M24***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[*x*] La struttura non è soggetta a fenomeni di condensa interstiziale.

[] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***15,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***ottobre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,000***	
Fattore di temperatura del componente	f_{RSI}	***0,662***	
Umidità relativa superficiale accettabile		***80***	%

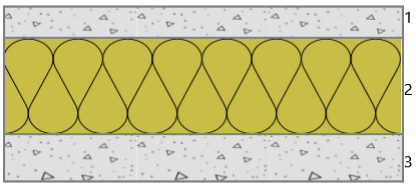
Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Non si verifica formazione di condensa interstiziale nella struttura durante tutto l'arco dell'anno.

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***PV1: vs terreno con vespaio*** **Codice:** ***P1***

Trasmittanza termica	***0,261***	W/m^2K
Trasmittanza controterra	***0,171***	W/m^2K
Spessore	***220***	mm
Temperatura esterna (calcolo potenza invernale)	***-5,1***	°C
Permeanza	***28,409***	$10^{-12}kg/sm^2Pa$
Massa superficiale (con intonaci)	***202***	kg/m^2
Massa superficiale (senza intonaci)	***202***	kg/m^2
Trasmittanza periodica	***0,181***	W/m^2K
Fattore attenuazione	***1,056***	-
Sfasamento onda termica	***-5,9***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,170	-	-	-
1	Sottofondo di cemento magro	40,00	0,7000	0,057	1600	0,88	20
2	Polistirene espanso, estruso senza pelle	120,00	0,0340	3,529	50	1,45	17
3	Massetto ripartitore in calcestruzzo con rete	60,00	1,4900	0,040	2200	0,88	70
-	Resistenza superficiale esterna	-	-	0,040	-	-	-

Legenda simboli

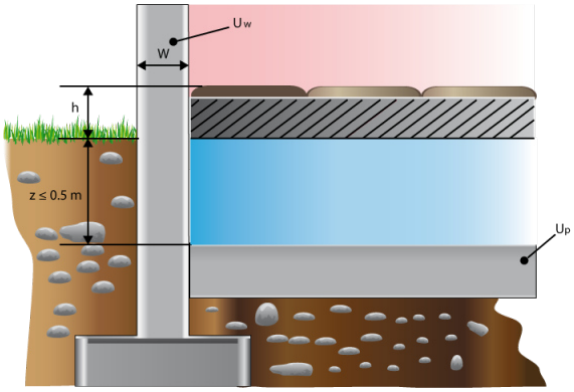
s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m^2K/W
M.V.	Massa volumica	kg/m^3
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

CALCOLO DELLA TRASMITTANZA CONTROTERRA secondo UNI EN ISO 13370

Pavimento su spazio aerato:

PV1: vs terreno con vespaio **Codice:** ***P1***

Area del pavimento		***250,00***	m²
Perimetro disperdente del pavimento		***40,00***	m
Spessore pareti perimetrali esterne		***463***	mm
Conduttività termica del terreno		***2,00***	W/mK
Altezza del pavimento dal terreno	h	***0,10***	m
Trasmittanza pareti dello spazio aerato	U_W	***0,24***	W/m²K
Trasmittanza pavimento dello spazio aerato	U_P	***2,12***	W/m²K
Area aperture ventilazione/m di perimetro	ε	***0,04***	m²/m
Coefficiente di protezione dal vento	f_W	***0,05***	



Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***PV1: vs terreno con vespaio*** **Codice:** ***P1***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[] La struttura non è soggetta a fenomeni di condensa interstiziale.

[*x*] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento		***20,0***	°C
Criterio per l'aumento dell'umidità interna		***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***aprile***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,481***	
Fattore di temperatura del componente	f_{RSI}	***0,936***	
Umidità relativa superficiale accettabile		***80***	%

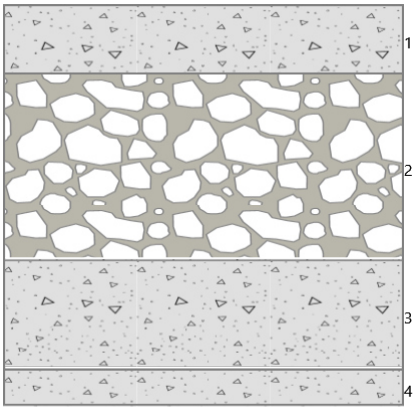
Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Verifica condensa interstiziale		***Positiva***	
Quantità massima di condensa durante l'anno	M_a	***71***	g/m²
Quantità di condensa ammissibile	M_{lim}	***100***	g/m²
Verifica di condensa ammissibile ($M_a \leq M_{lim}$)		***Positiva***	
Mese con massima condensa accumulata		***luglio***	
L'evaporazione a fine stagione è		***Completa***	

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***PV2: vs terreno*** **Codice:** ***P2***

Trasmittanza termica	***0,680***	W/m^2K
Trasmittanza controterra	***0,149***	W/m^2K
Spessore	***1100***	mm
Temperatura esterna (calcolo potenza invernale)	***-5,1***	°C
Permeanza	***4,137***	$10^{-12}kg/sm^2Pa$
Massa superficiale (con intonaci)	***1969***	kg/m^2
Massa superficiale (senza intonaci)	***1969***	kg/m^2
Trasmittanza periodica	***0,001***	W/m^2K
Fattore attenuazione	***0,005***	-
Sfasamento onda termica	***-33,7***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale interna	-	-	0,170	-	-	-
1	Sottofondo di cemento magro	190,00	0,7000	0,271	1600	0,88	20
2	Ciotoli e pietre frantumati (um. 2%)	510,00	0,7000	0,729	1500	1,00	5
3	C.l.s. con massa volumica alta	300,00	2,0000	0,150	2400	1,00	130
4	Sottofondo di cemento magro	100,00	0,9000	0,111	1800	0,88	30
-	Resistenza superficiale esterna	-	-	0,040	-	-	-

Legenda simboli

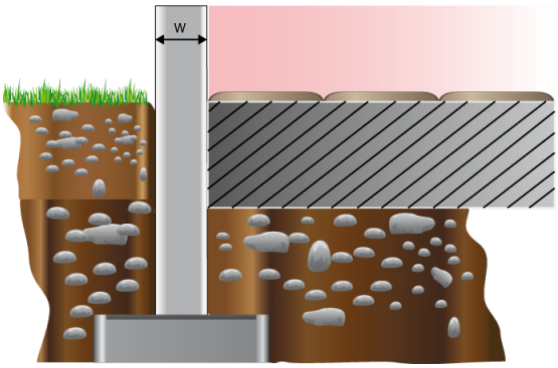
s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m^2K/W
M.V.	Massa volumica	kg/m^3
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

CALCOLO DELLA TRASMITTANZA CONTROTERRA secondo UNI EN ISO 13370

Pavimento appoggiato su terreno:

PV2: vs terreno **Codice:** ***P2***

Area del pavimento		***775,00***	m²
Perimetro disperdente del pavimento		***65,00***	m
Spessore pareti perimetrali esterne		***601***	mm
Conduttività termica del terreno		***2,00***	W/mK
Posizione isolante		***2***	
Larghezza dell'isolamento di bordo	D	***0,70***	m
Spessore dello strato isolante	d_n	***0,10***	m
Conduttività termica dell'isolante		***0,046***	W/mK



Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***PV2: vs terreno*** **Codice:** ***P2***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[] La struttura non è soggetta a fenomeni di condensa interstiziale.

[*x*] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,006 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***aprile***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,574***	
Fattore di temperatura del componente	f_{RSI}	***0,839***	
Umidità relativa superficiale accettabile		***80***	%

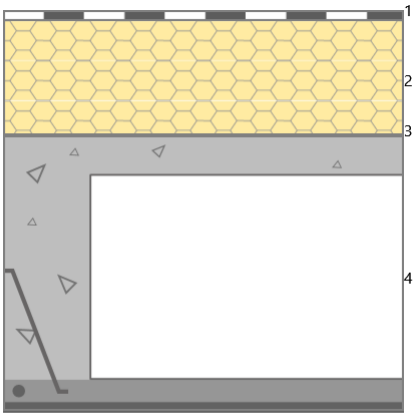
Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Verifica condensa interstiziale		***Positiva***	
Quantità massima di condensa durante l'anno	M_a	***7***	g/m²
Quantità di condensa ammissibile	M_{lim}	***100***	g/m²
Verifica di condensa ammissibile ($M_a \leq M_{lim}$)		***Positiva***	
Mese con massima condensa accumulata		***luglio***	
L'evaporazione a fine stagione è		***Completa***	

CARATTERISTICHE TERMICHE E IGROMETRICHE DEI COMPONENTI OPACHI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 13370

Descrizione della struttura: ***CO1 - Verso esterno*** **Codice:** ***S1***

Trasmittanza termica	***0,143***	W/m²K
Spessore	***580***	mm
Temperatura esterna (calcolo potenza invernale)	***-5,1***	°C
Permeanza	***0,249***	10^{-12}kg/sm²Pa
Massa superficiale (con intonaci)	***565***	kg/m²
Massa superficiale (senza intonaci)	***565***	kg/m²
Trasmittanza periodica	***0,000***	W/m²K
Fattore attenuazione	***0,000***	-
Sfasamento onda termica	***-27,2***	h



Stratigrafia:

N.	Descrizione strato	s	Cond.	R	M.V.	C.T.	R.V.
-	Resistenza superficiale esterna	-	-	0,089	-	-	-
1	Impermeabilizzazione con PVC in fogli	15,00	0,1700	0,088	1390	0,90	50000
2	Pannello isolante per tetto piano	165,00	0,0260	6,346	32	1453,00	148
3	INTELLO; Freno al vapore Hydrosafe® ad alte prestazioni per coibenti fibrosi in stuoia o pannello	0,25	0,0400	0,006	340	1,00	30000
4	Copertura - 40 cm	400,00	1,0700	0,374	1346	0,89	57
-	Resistenza superficiale interna	-	-	0,100	-	-	-

Legenda simboli

s	Spessore	mm
Cond.	Conduttività termica, comprensiva di eventuali coefficienti correttivi	W/mK
R	Resistenza termica	m²K/W
M.V.	Massa volumica	kg/m³
C.T.	Capacità termica specifica	kJ/kgK
R.V.	Fattore di resistenza alla diffusione del vapore in capo asciutto	-

Caratteristiche igrometriche dei componenti opachi
secondo UNI EN ISO 13788

Descrizione della struttura: ***CO1 - Verso esterno*** **Codice:** ***S1***

[*x*] La struttura non è soggetta a fenomeni di condensa superficiale.

[] La struttura non è soggetta a fenomeni di condensa interstiziale.

[*x*] La struttura è soggetta a fenomeni di condensa interstiziale, ma la quantità è rievaporabile durante la stagione estiva.

Condizioni al contorno

Temperature e umidità relativa esterne variabili, medie mensili

Temperatura interna nel periodo di riscaldamento	***20,0***	°C
Criterio per l'aumento dell'umidità interna	***Classe di concentrazione del vapore (0,004 kg/m³)***	

Verifica criticità di condensa superficiale

Verifica condensa superficiale ($f_{RSI,max} \leq f_{RSI}$)		***Positiva***	
Mese critico		***dicembre***	
Fattore di temperatura del mese critico	$f_{RSI,max}$	***0,651***	
Fattore di temperatura del componente	f_{RSI}	***0,965***	
Umidità relativa superficiale accettabile		***80***	%

Verifica del rischio di condensa interstiziale (secondo UNI EN ISO 13788)

Verifica condensa interstiziale		***Positiva***	
Quantità massima di condensa durante l'anno	M_a	***16***	g/m²
Quantità di condensa ammissibile	M_{lim}	***100***	g/m²
Verifica di condensa ammissibile ($M_a \leq M_{lim}$)		***Positiva***	
Mese con massima condensa accumulata		***febbraio***	
L'evaporazione a fine stagione è		***Completa***	

CARATTERISTICHE TERMICHE DEI COMPONENTI FINESTRATI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 10077

Descrizione della finestra: ***F1 : 15x2M*** **Codice:** ***W1***

Il serramento è un modulo di facciata continua.

Caratteristiche del serramento

Tipologia di serramento		***Singolo***	
Classe di permeabilità		***Classe 4 secondo Norma UNI EN 12207***	
Trasmittanza termica	U_{cw}	***1,306***	W/m^2K
Trasmittanza solo vetro	U_g	***0,896***	W/m^2K

Dati per il calcolo degli apporti solari e delle schermature

Emissività	ε	***0,837***	-
Fattore di trasmittanza solare	$g_{gl,n}$	***0,350***	-
Fattore tendaggi (invernale)	$f_{c\ inv}$	***1,00***	-
Fattore tendaggi (estivo)	$f_{c\ est}$	***1,00***	-
Fattore trasmissione solare totale	g_{gl+sh}	***0,342***	-

Caratteristiche delle chiusure oscuranti

Resistenza termica chiusure		***0,00***	m^2K/W
f shut		***0,6***	-
Trasmittanza serramento *	$U_{w,e}$	***1,306***	W/m^2K

* Valore calcolato considerando l'effetto della chiusura oscurante (UNI EN ISO 10077)

Dimensioni e caratteristiche del serramento

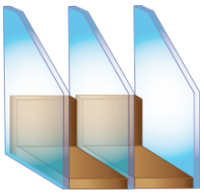
Larghezza	***1505,0***	cm
Altezza H	***200,0***	cm

Caratteristiche del telaio

Trasmittanza termica del telaio	U_f	***1,10***	W/m^2K
K distanziale	K_d	***0,110***	W/mK
Area totale	A_w	***30,100***	m^2
Area vetro	A_g	***27,075***	m^2
Area telaio	A_f	***3,025***	m^2
Fattore di forma	F_f	***0,90***	-
Perimetro vetro	L_g	***85,500***	m

Stratigrafia del pacchetto vetrato

Descrizione strato	s	λ	R
Resistenza superficiale interna	-	-	0,130
Primo vetro	8,0	1,00	0,008
Intercapedine	-	-	0,440
Secondo vetro	4,0	1,00	0,004
Intercapedine	-	-	0,440
Terzo vetro	6,0	1,00	0,006
Resistenza superficiale esterna	-	-	0,089



Legenda simboli

s	Spessore	mm
λ	Conduttività termica	W/mK
R	Resistenza termica	m^2K/W

Caratteristiche del modulo

Trasmittanza termica del modulo	U	***1,306***	W/m^2K

Traversi e montanti del modulo di facciata continua

Traversi

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_t	***2,5***	cm
Area	A_t	***0,38***	m^2

Montanti

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_m	***5,0***	cm
Area	A_m	***0,10***	m^2

Ponte termico tra montante/traverso e infisso

Lunghezza perimetrale	***34,1***	m
Trasmittanza termica lineica	***0,070***	W/mK

CARATTERISTICHE TERMICHE DEI COMPONENTI FINESTRATI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 10077

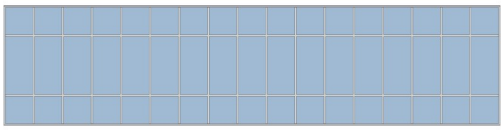
Descrizione della finestra: ***F2 : 16.6 x 4M*** **Codice:** ***W2***

Il serramento è un modulo di facciata continua.

Caratteristiche del serramento

Tipologia di serramento		***Singolo***	
Classe di permeabilità		***Classe 4 secondo Norma UNI EN 12207***	
Trasmittanza termica	U_{cw}	***1,329***	W/m^2K
Trasmittanza solo vetro	U_g	***0,896***	W/m^2K

Dati per il calcolo degli apporti solari e delle schermature



Emissività	ε	***0,837***	-
Fattore di trasmittanza solare	$g_{gl,n}$	***0,350***	-
Fattore tendaggi (invernale)	$f_{c\ inv}$	***1,00***	-
Fattore tendaggi (estivo)	$f_{c\ est}$	***1,00***	-
Fattore trasmissione solare totale	g_{gl+sh}	***0,342***	-

Caratteristiche delle chiusure oscuranti

Resistenza termica chiusure		***0,00***	m^2K/W
f shut		***0,6***	-
Trasmittanza serramento *	$U_{w,e}$	***1,329***	W/m^2K

* Valore calcolato considerando l'effetto della chiusura oscurante (UNI EN ISO 10077)

Dimensioni e caratteristiche del serramento

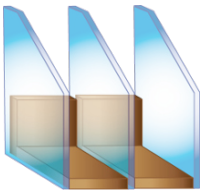
Larghezza	***1660,0***	cm
Altezza H	***400,0***	cm

Caratteristiche del telaio

Trasmittanza termica del telaio	U_f	***1,10***	W/m^2K
K distanziale	K_d	***0,110***	W/mK
Area totale	A_w	***66,400***	m^2
Area vetro	A_g	***59,660***	m^2
Area telaio	A_f	***6,740***	m^2
Fattore di forma	F_f	***0,90***	-
Perimetro vetro	L_g	***223,400***	m

Stratigrafia del pacchetto vetrato

Descrizione strato	s	λ	R
Resistenza superficiale interna	-	-	0,130
Primo vetro	8,0	1,00	0,008
Intercapedine	-	-	0,440
Secondo vetro	4,0	1,00	0,004
Intercapedine	-	-	0,440
Terzo vetro	6,0	1,00	0,006
Resistenza superficiale esterna	-	-	0,089



Legenda simboli

s	Spessore	mm
λ	Conduttività termica	W/mK
R	Resistenza termica	m^2K/W

Caratteristiche del modulo

Trasmittanza termica del modulo	U	***1,329***	W/m^2K

Traversi e montanti del modulo di facciata continua

Traversi

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_t	***2,5***	cm
Area	A_t	***0,42***	m^2

Montanti

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_m	***5,0***	cm
Area	A_m	***0,20***	m^2

Ponte termico tra montante/traverso e infisso

Lunghezza perimetrale	***41,2***	m
Trasmittanza termica lineica	***0,070***	W/mK

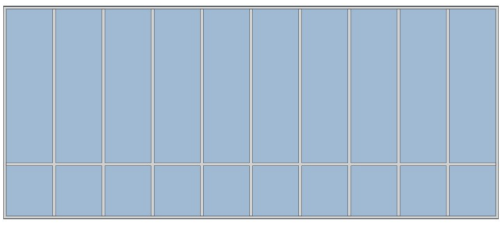
CARATTERISTICHE TERMICHE DEI COMPONENTI FINESTRATI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 10077

Descrizione della finestra: ***F3 : 9.3 X 4 M*** **Codice:** ***W3***

Il serramento è un modulo di facciata continua.

Caratteristiche del serramento

Tipologia di serramento		***Singolo***	
Classe di permeabilità		***Classe 4 secondo Norma UNI EN 12207***	
Trasmittanza termica	U_{cw}	***1,295***	W/m^2K
Trasmittanza solo vetro	U_g	***0,896***	W/m^2K



Dati per il calcolo degli apporti solari e delle schermature

Emissività	ε	***0,837***	-
Fattore di trasmittanza solare	$g_{gl,n}$	***0,350***	-
Fattore tendaggi (invernale)	$f_{c\ inv}$	***1,00***	-
Fattore tendaggi (estivo)	$f_{c\ est}$	***1,00***	-
Fattore trasmissione solare totale	g_{gl+sh}	***0,342***	-

Caratteristiche delle chiusure oscuranti

Resistenza termica chiusure		***1,00***	m^2K/W
f shut		***0,6***	-
Trasmittanza serramento *	$U_{w,e}$	***0,857***	W/m^2K

* Valore calcolato considerando l'effetto della chiusura oscurante (UNI EN ISO 10077)

Dimensioni e caratteristiche del serramento

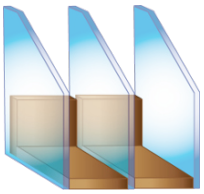
Larghezza	***930,0***	cm
Altezza H	***400,0***	cm

Caratteristiche del telaio

Trasmittanza termica del telaio	U_f	***1,10***	W/m^2K
K distanziale	K_d	***0,110***	W/mK
Area totale	A_w	***37,200***	m^2
Area vetro	A_g	***33,688***	m^2
Area telaio	A_f	***3,513***	m^2
Fattore di forma	F_f	***0,91***	-
Perimetro vetro	L_g	***112,000***	m

Stratigrafia del pacchetto vetrato

Descrizione strato	s	λ	R
Resistenza superficiale interna	-	-	0,130
Primo vetro	8,0	1,00	0,008
Intercapedine	-	-	0,440
Secondo vetro	4,0	1,00	0,004
Intercapedine	-	-	0,440
Terzo vetro	6,0	1,00	0,006
Resistenza superficiale esterna	-	-	0,089



Legenda simboli

s	Spessore	mm
λ	Conduttività termica	W/mK
R	Resistenza termica	m^2K/W

Caratteristiche del modulo

Trasmittanza termica del modulo	U	***0,857***	W/m^2K

Traversi e montanti del modulo di facciata continua

Traversi

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_t	***2,5***	cm
Area	A_t	***0,23***	m^2

Montanti

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_m	***5,0***	cm
Area	A_m	***0,20***	m^2

Ponte termico tra montante/traverso e infisso

Lunghezza perimetrale	***26,6***	m
Trasmittanza termica lineica	***0,070***	W/mK

CARATTERISTICHE TERMICHE DEI COMPONENTI FINESTRATI
secondo UNI TS 11300-1 - UNI EN ISO 6946 - UNI EN ISO 10077

Descrizione della finestra: ***F4 : 29.3 X 4 M*** **Codice:** ***W4***

Il serramento è un modulo di facciata continua.

Caratteristiche del serramento

Tipologia di serramento		***Singolo***	
Classe di permeabilità		***Classe 4 secondo Norma UNI EN 12207***	
Trasmittanza termica	U_{cw}	***1,325***	W/m^2K
Trasmittanza solo vetro	U_g	***0,896***	W/m^2K

Dati per il calcolo degli apporti solari e delle schermature

Emissività	ε	***0,837***	-
Fattore di trasmittanza solare	$g_{gl,n}$	***0,350***	-
Fattore tendaggi (invernale)	$f_{c\ inv}$	***1,00***	-
Fattore tendaggi (estivo)	$f_{c\ est}$	***1,00***	-
Fattore trasmissione solare totale	g_{gl+sh}	***0,342***	-

Caratteristiche delle chiusure oscuranti

Resistenza termica chiusure		***0,00***	m^2K/W
f shut		***0,6***	-
Trasmittanza serramento *	$U_{w,e}$	***1,325***	W/m^2K

* Valore calcolato considerando l'effetto della chiusura oscurante (UNI EN ISO 10077)

Dimensioni e caratteristiche del serramento

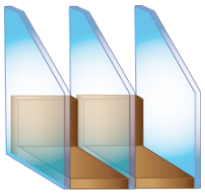
Larghezza	***2930,0***	cm
Altezza H	***400,0***	cm

Caratteristiche del telaio

Trasmittanza termica del telaio	U_f	***1,10***	W/m^2K
K distanziale	K_d	***0,110***	W/mK
Area totale	A_w	***117,200***	m^2
Area vetro	A_g	***105,450***	m^2
Area telaio	A_f	***11,750***	m^2
Fattore di forma	F_f	***0,90***	-
Perimetro vetro	L_g	***394,500***	m

Stratigrafia del pacchetto vetrato

Descrizione strato	s	λ	R
Resistenza superficiale interna	-	-	0,130
Primo vetro	8,0	1,00	0,008
Intercapedine	-	-	0,440
Secondo vetro	4,0	1,00	0,004
Intercapedine	-	-	0,440
Terzo vetro	6,0	1,00	0,006
Resistenza superficiale esterna	-	-	0,089



Legenda simboli

s	Spessore	mm
λ	Conduttività termica	W/mK
R	Resistenza termica	m^2K/W

Caratteristiche del modulo

Trasmittanza termica del modulo	U	***1,325***	W/m^2K

Traversi e montanti del modulo di facciata continua

Traversi

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_t	***2,5***	cm
Area	A_t	***0,73***	m^2

Montanti

Trasmittanza termica	U	***1,200***	W/m^2K
Spessore	s_m	***5,0***	cm
Area	A_m	***0,20***	m^2

Ponte termico tra montante/traverso e infisso

Lunghezza perimetrale	***66,6***	m
Trasmittanza termica lineica	***0,070***	W/mK

FABBISOGNO DI ENERGIA UTILE INVERNALE
secondo UNI EN ISO 13790 e UNI TS 11300-1

Dati climatici della località:

Località	***Siziano***	
Provincia	***Pavia***	
Altitudine s.l.m.	***93***	m
Gradi giorno	***2601***	
Zona climatica	***E***	
Temperatura esterna di progetto	***-5,1***	°C

Irradiazione solare giornaliera media mensile:

Esposizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Nord	MJ/m²	*1,6*	*2,4*	*3,7*	*5,3*	*8,4*	*10,2*	*9,7*	*6,8*	*4,5*	*2,8*	*1,8*	*1,3*
Nord-Est	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Est	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Sud-Est	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Sud	MJ/m²	*10,1*	*11,2*	*13,4*	*10,6*	*10,5*	*10,6*	*11,1*	*11,3*	*12,6*	*8,7*	*10,7*	*7,6*
Sud-Ovest	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Ovest	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Nord-Ovest	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Orizz. Diffusa	MJ/m²	*2,1*	*3,2*	*4,7*	*6,6*	*9,5*	*9,6*	*9,0*	*7,5*	*5,7*	*4,1*	*2,5*	*1,9*
Orizz. Diretta	MJ/m²	*2,9*	*4,6*	*8,6*	*9,5*	*11,1*	*14,1*	*15,1*	*12,2*	*9,8*	*3,8*	*3,5*	*1,9*

Edificio : MIL07 Data Center

Temperature esterne medie e numero di giorni nella stagione considerata:

Descrizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Temperatura	°C	*1,4*	*4,5*	*9,4*	*11,9*	-	-	-	-	-	*12,1*	*6,4*	*1,5*
N° giorni	-	*31*	*28*	*31*	*15*	-	-	-	-	-	*17*	*30*	*31*

Opzioni di calcolo:

Metodologia di calcolo	***Vicini presenti***				
Stagione di calcolo	***Convenzionale***	dal	***15 ottobre***	al	***15 aprile***
Durata della stagione	***183***	giorni			

Dati geometrici:

Superficie in pianta netta	***1663,31***	m^2
Superficie esterna lorda	***3485,09***	m^2
Volume netto	***7835,96***	m^3
Volume lordo	***10379,24***	m^3
Rapporto S/V	***0,34***	m^{-1}

FABBISOGNO DI ENERGIA UTILE STAGIONE INVERNALE
Sommario perdite e apporti

Edificio : MIL07 Data Center

Categoria DPR 412/93	***E.2***	-	Superficie esterna	***3485,09***	m^2
Superficie utile	***1663,31***	m^2	Volume lordo	***10379,24***	m^3
Volume netto	***7835,96***	m^3	Rapporto S/V	***0,34***	m^{-1}

Dispersioni, apporti e fabbisogno di energia utile:

Mese	$Q_{H,tr}$ [kWh]	$Q_{H,r}$ [kWh]	$Q_{H,ve}$ [kWh]	$Q_{H,ht}$ [kWh]$_t$	$Q_{sol,k,w}$ [kWh]	Q_{int} [kWh]	Q_{gn} [kWh]	$Q_{H,nd}$ [kWh]
Ottobre	*2680*	*465*	*5960*	*9104*	*1887*	*4072*	*5959*	*3426*
Novembre	*9355*	*1164*	*18136*	*28655*	*3055*	*7185*	*10241*	*18462*
Dicembre	*13863*	*1068*	*25493*	*40423*	*2142*	*7425*	*9567*	*30864*
Gennaio	*13858*	*1270*	*25630*	*40758*	*2792*	*7425*	*10217*	*30552*
Febbraio	*10078*	*1023*	*19292*	*30393*	*3342*	*6706*	*10048*	*20379*
Marzo	*6835*	*1541*	*14607*	*22982*	*5448*	*7425*	*12873*	*10465*
Aprile	*2275*	*632*	*5416*	*8323*	*2908*	*3593*	*6501*	*2376*
Totali	***58944***	***7163***	***114533***	***180639***	***21576***	***43832***	***65407***	***116524***

Legenda simboli

$Q_{H,tr}$	Energia dispersa per trasmissione dedotti gli apporti solari diretti attravesto le strutture opache ($Q_{sol,k,H}$)
$Q_{H,r}$	Energia dispersa per extraflusso
$Q_{H,ve}$	Energia dispersa per ventilazione
$Q_{H,ht}$	Totale energia dispersa = $Q_{H,tr}$ + $Q_{H,ve}$
$Q_{sol,k,w}$	Apporti solari attraverso gli elementi finestrati
Q_{int}	Apporti interni
Q_{gn}	Totale apporti gratuiti = Q_{sol} + Q_{int}
$Q_{H,nd}$	Energia utile

FABBISOGNO DI ENERGIA UTILE ESTIVA
secondo UNI EN ISO 13790 e UNI TS 11300-1

Dati climatici della località:

Località	***Siziano***	
Provincia	***Pavia***	
Altitudine s.l.m.	***93***	m
Gradi giorno	***2601***	
Zona climatica	***E***	
Temperatura esterna di progetto	***-5,1***	°C

Irradiazione solare giornaliera media mensile:

Esposizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Nord	MJ/m²	*1,6*	*2,4*	*3,7*	*5,3*	*8,4*	*10,2*	*9,7*	*6,8*	*4,5*	*2,8*	*1,8*	*1,3*
Nord-Est	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Est	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Sud-Est	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Sud	MJ/m²	*10,1*	*11,2*	*13,4*	*10,6*	*10,5*	*10,6*	*11,1*	*11,3*	*12,6*	*8,7*	*10,7*	*7,6*
Sud-Ovest	MJ/m²	*7,8*	*9,3*	*12,6*	*11,7*	*12,6*	*13,4*	*14,0*	*13,2*	*13,0*	*7,7*	*8,4*	*5,8*
Ovest	MJ/m²	*4,2*	*6,2*	*9,9*	*11,1*	*13,4*	*15,3*	*15,7*	*13,3*	*11,1*	*5,8*	*5,0*	*3,2*
Nord-Ovest	MJ/m²	*1,8*	*3,1*	*5,8*	*8,0*	*11,1*	*13,1*	*13,0*	*10,1*	*7,2*	*3,6*	*2,2*	*1,4*
Orizz. Diffusa	MJ/m²	*2,1*	*3,2*	*4,7*	*6,6*	*9,5*	*9,6*	*9,0*	*7,5*	*5,7*	*4,1*	*2,5*	*1,9*
Orizz. Diretta	MJ/m²	*2,9*	*4,6*	*8,6*	*9,5*	*11,1*	*14,1*	*15,1*	*12,2*	*9,8*	*3,8*	*3,5*	*1,9*

Edificio : MIL07 Data Center

Temperature esterne medie e numero di giorni nella stagione considerata:

Descrizione	u.m.	Gen	Feb	Mar	Apr	Mag	Giu	Lug	Ago	Set	Ott	Nov	Dic
Temperatura	°C	-	-	*11,0*	*12,6*	*18,4*	*22,4*	*24,1*	*22,6*	*17,8*	*15,0*	-	-
N° giorni	-	-	-	*2*	*30*	*31*	*30*	*31*	*31*	*30*	*15*	-	-

Opzioni di calcolo:

Metodologia di calcolo	***Vicini presenti***				
Stagione di calcolo	***Reale***	dal	***30 marzo***	al	***15 ottobre***
Durata della stagione	***200***	giorni			

Dati geometrici:

Superficie in pianta netta	***1663,31***	m^2
Superficie esterna lorda	***3485,09***	m^2
Volume netto	***7835,96***	m^3
Volume lordo	***10379,24***	m^3
Rapporto S/V	***0,34***	m^{-1}

FABBISOGNO DI ENERGIA UTILE STAGIONE ESTIVA
Sommario perdite e apporti

Edificio : MIL07 Data Center

Categoria DPR 412/93	***E.2***	-	Superficie esterna	***3485,09***	m^2
Superficie utile	***1663,31***	m^2	Volume lordo	***10379,24***	m^3
Volume netto	***7835,96***	m^3	Rapporto S/V	***0,34***	m^{-1}

Dispersioni, apporti e fabbisogno di energia utile:

Mese	$Q_{C,tr}$ [kWh]	$Q_{C,r}$ [kWh]	$Q_{C,ve}$ [kWh]	$Q_{C,ht}$ [kWh]$_t$	$Q_{sol,k,w}$ [kWh]	Q_{int} [kWh]	Q_{gn} [kWh]	$Q_{C,nd}$ [kWh]
Marzo	*961*	*111*	*1334*	*2406*	*351*	*479*	*831*	*0*
Aprile	*12727*	*1347*	*17869*	*31944*	*5817*	*7185*	*13002*	*2*
Maggio	*6906*	*1840*	*10473*	*19219*	*7415*	*7425*	*14840*	*355*
Giugno	*2513*	*1702*	*4801*	*9015*	*8084*	*7185*	*15269*	*6286*
Luglio	*797*	*1668*	*2618*	*5083*	*8429*	*7425*	*15854*	*10770*
Agosto	*2547*	*1299*	*4685*	*8531*	*7104*	*7425*	*14529*	*6028*
Settembre	*7468*	*1458*	*10935*	*19860*	*5820*	*7185*	*13005*	*100*
Ottobre	*5353*	*577*	*7359*	*13288*	*1665*	*3593*	*5258*	*1*
Totali	***39272***	***10003***	***60073***	***109347***	***44685***	***47903***	***92588***	***23543***

Legenda simboli

$Q_{C,tr}$	Energia dispersa per trasmissione dedotti gli apporti solari diretti attravesto le strutture opache ($Q_{sol,k,C}$)
$Q_{C,r}$	Energia dispersa per extraflusso
$Q_{C,ve}$	Energia dispersa per ventilazione
$Q_{C,ht}$	Totale energia dispersa = $Q_{C,tr}$ + $Q_{C,ve}$
$Q_{sol,k,w}$	Apporti solari attraverso gli elementi finestrati
Q_{int}	Apporti interni
Q_{gn}	Totale apporti gratuiti = Q_{sol} + Q_{int}
$Q_{C,nd}$	Energia utile

FABBISOGNI E CONSUMI TOTALI

Edificio : MIL07 Data Center	DPR 412/93	*E.2*	Superficie utile	*1663,31*	m^2

Fabbisogno di energia primaria e indici di prestazione

Servizio	Qp,nren [kWh]	Qp,ren [kWh]	Qp,tot [kWh]	EP,nren [kWh/m²]	EP,ren [kWh/m²]	EP,tot [kWh/m²]
Riscaldamento	*1321*	*41793*	*43114*	*0,79*	*25,13*	*25,92*
Acqua calda sanitaria	*56*	*5185*	*5241*	*0,03*	*3,12*	*3,15*
Raffrescamento	*0*	*9113*	*9113*	*0,00*	*5,48*	*5,48*
Ventilazione	*381*	*14146*	*14527*	*0,23*	*8,50*	*8,73*
Illuminazione	*1420*	*49072*	*50492*	*0,85*	*29,50*	*30,36*
Trasporto	*4884*	*1177*	*6061*	*2,94*	*0,71*	*3,64*
TOTALE	*8062*	*120486*	*128548*	*4,85*	*72,44*	*77,28*

Vettori energetici ed emissioni di CO_2

Vettore energetico	Consumo	U.M.	CO_2 [kg/anno]	Servizi
Energia elettrica	*4134*	*kWhel/anno*	*1902*	*Riscaldamento, Acqua calda sanitaria, Ventilazione, Illuminazione, Trasporto*

Zona 1 : Zona uffici	DPR 412/93	*E.2*	Superficie utile	*1663,31*	m^2

Fabbisogno di energia primaria e indici di prestazione

Servizio	Qp,nren [kWh]	Qp,ren [kWh]	Qp,tot [kWh]	EP,nren [kWh/m²]	EP,ren [kWh/m²]	EP,tot [kWh/m²]
Riscaldamento	*1321*	*41793*	*43114*	*0,79*	*25,13*	*25,92*
Acqua calda sanitaria	*56*	*5185*	*5241*	*0,03*	*3,12*	*3,15*
Raffrescamento	*0*	*9113*	*9113*	*0,00*	*5,48*	*5,48*
Ventilazione	*381*	*14146*	*14527*	*0,23*	*8,50*	*8,73*
Illuminazione	*1420*	*49072*	*50492*	*0,85*	*29,50*	*30,36*
TOTALE	*3178*	*119309*	*122487*	*1,91*	*71,73*	*73,64*

Vettori energetici ed emissioni di CO_2

Vettore energetico	Consumo	U.M.	CO_2 [kg/anno]	Servizi
Energia elettrica	*1630*	*kWhel/anno*	*750*	*Riscaldamento, Acqua calda sanitaria, Ventilazione, Illuminazione*

RIASSUNTO VERIFICHE DI LEGGE

Impianto: ***MIL07 Data Center***

Verifiche secondo: ***DDUO 18.12.19 n. 18546***

Fase	***Fase II – 1 Gennaio 2017 per tutti gli edifici***
Intervento	***Edifici di nuova costruzione***
Limiti	***Limiti dal 1 Gennaio 2017 per tutti gli edifici***

Elenco verifiche:

Tipo verifica	Esito	Valore ammissibile		Valore calcolato	u.m.
Verifica termoigrometrica	***Positiva***				
Verifica sulla temperatura critica interna del ponte termico	***Positiva***				
Trasmittanza media divisori e strutture locali non climatizzati	***Positiva***				
Indice di prestazione termica utile per riscaldamento	***Positiva***	***73,60***	>	***70,06***	*kWh/m²*
Indice di prestazione termica utile per il raffrescamento	***Positiva***	***15,34***	>	***14,15***	*kWh/m²*
Indice di prestazione energetica globale	***Positiva***	***91,16***	>	***73,64***	*kWh/m²*
Area solare equivalente estiva per unità di superficie utile	***Positiva***				
Coefficiente medio globale di scambio termico per trasmissione (H't)	***Positiva***				
Efficienza media stagionale dell'impianto per servizi riscaldamento, acqua calda sanitaria e raffrescamento	***Positiva***				

Dettagli – Verifica termoigrometrica :

Cod.	Tipo	Descrizione	Condensa superficiale	Condensa interstiziale
M1	*T*	*CV1 - Parete vs esterno (con cls)*	*Positiva*	*Positiva*
M2	*T*	*CV2 - Parete vs esterno (con controparete)*	*Positiva*	*Positiva*
M11	*U*	*CV11 - vs locale tecnico (cls espanso)*	*Positiva*	*Positiva*
M12	*U*	*CV12 - vs non riscaldato (cls espanso - No pareti esterne)*	*Positiva*	*Positiva*
M13	*U*	*CV13 - vs non riscaldato (cls espanso - 15°C)*	*Positiva*	*Positiva*
M14	*A*	*CV14 - vs DX*	*Positiva*	*Positiva*
M15	*A*	*CV15 - vs locale critico*	*Positiva*	*Positiva*
M21	*U*	*CV21: vs non climatizzato (vs scala - semplificato - 1 parete esterna)*	*Positiva*	*Positiva*
M22	*U*	*CV22: vs non climatizzato (vs scala con controparete - 1 parete esterna)*	*Positiva*	*Positiva*
M23	*U*	*CV23: vs non climatizzato (vs scala con controparete - 1 parete esterna)*	*Positiva*	*Positiva*
M24	*U*	*CV24: vs non climatizzato (vs scala - 15°C)*	*Positiva*	*Positiva*
M31	*U*	*CV31 - Porta vs locale tecnico*	*Positiva*	*Positiva*
M32	*A*	*CV32 - Porta vs locale critico*	*Positiva*	*Positiva*

M33	A	CV33 - Porta vs locale DX	Positiva	Positiva
M34	T	CV34 - Porta corridoio p1 vs esterno	Positiva	Positiva
M35	T	CV35 - Vs esterno	Positiva	Positiva
M36	T	CV36 - Vs esterno (portone lobby)	Positiva	Positiva
P1	G	PV1: vs terreno con vespaio	Positiva	Positiva
P2	G	PV2: vs terreno	Positiva	Positiva
P11	A	PV-11: vs DX	Positiva	Positiva
P12	A	PV-12: vs locale critico	Positiva	Positiva
P13	U	PV-13: vs locale tecnico	Positiva	Positiva
S1	T	CO1 - Verso esterno	Positiva	Positiva

Dettagli – Verifica sulla temperatura critica interna del ponte termico :

Cod.	Descrizione	Verifica rischio muffa
Z11	PI11 - Parete con controparete - Solaio interpiano (zona magazzini)	Positiva
Z31	PT1 - Parete con controparete - Telaio	Positiva
Z21	PS1 - Parete con controparete (locale riscaldato) - Solaio con vespaio	Positiva
Z28	GF28 - Parete blocchetti - Solaio controterra	Positiva
Z12	PI12 - Parete con controparete - Solaio interpiano (zona uffici)	Positiva
Z1	PC1 - Parete con controparete - Copertura	Positiva

Dettagli – Trasmittanza media divisori e strutture locali non climatizzati :

Cod.	Tipo	Descrizione	Verifica	U amm. [W/m²K]		U media [W/m²K]	U [W/m²K]
M100	R	Parete vespaio	Positiva	0,800	≥	0,244	0,244

Dettagli – Indice di prestazione termica utile per riscaldamento :

Riferimento: DDUO 18.12.19 n. 18546, paragrafo 6, punto 6.12

Su [m²]	Qh,nd amm. [kWh]	Qh,nd [kWh]
1663,31	122427,28	116524,03

Dettagli – Indice di prestazione termica utile per il raffrescamento :

Riferimento: DDUO 18.12.19 n. 18546, paragrafo 6, punto 6.12

Su [m²]	Qc,nd amm. [kWh]	Qc,nd [kWh]
1663,31	25518,32	23542,71

Dettagli – Indice di prestazione energetica globale :

Riferimento: DDUO 18.12.19 n. 18546, paragrafo 6, punto 6.12

Servizio	EP ed. riferimento [kWh/m²]	EP [kWh/m²]
Riscaldamento	33,06	25,92
Acqua calda sanitaria	3,33	3,15
Raffrescamento	14,15	5,48
Ventilazione	9,71	8,73
Illuminazione	30,91	30,36
Trasporto	0,00	0,00
TOTALE	91,16	73,64

Dettagli – Area solare equivalente estiva per unità di superficie utile :

Nr.	Descrizione	Verifica	Asol,eq,amm		Asol,eq	Asol	Su

			[-]		[-]	[m²]	[m²]
1	*Zona uffici*	*Positiva*	*0,040*	≥	*0,038*	*62,75*	*1663,31*

Dettagli – Coefficiente medio globale di scambio termico per trasmissione (H't) :

Nr.	Descrizione	Cat. DPR. 412	H't amm. [W/m²K]		H't [W/m²K]
1	*Zona uffici*	*E.2*	*0,75*	≥	*0,25*

Dettagli – Efficienza media stagionale dell'impianto per servizi riscaldamento, acqua calda sanitaria e raffrescamento :

Nr.	Servizi	Verifica	ηg amm [%]		ηg [%]
1	*Riscaldamento*	*Positiva*	*222,6*	≤	*270,3*
2	*Acqua calda sanitaria*	*Positiva*	*69,0*	≤	*72,9*
3	*Raffrescamento*	*Positiva*	*108,4*	≤	*258,3*

Verifiche secondo: ***DLgs 8 Novembre 2021 n.199***

Intervento	***Edificio di nuova costruzione***
Verifiche secondo DLgs.n. 199/2021, Allegato 3, punto 2	[***X***]

Elenco verifiche:

Tipo verifica	Esito	Valore ammissibile		Valore calcolato	u.m.
Copertura totale da fonte rinnovabile	***Positiva***	***60,00***	<	***97,60***	*%*
Copertura acqua sanitaria da fonte rinnovabile	***Positiva***	***60,00***	<	***98,93***	*%*
Verifica potenza elettrica installata	***Positiva***	***314,00***	≤	***320,00***	*kW*

Dettagli – Copertura totale da fonte rinnovabile :

Riferimento: DLgs 8.11.2021 n. 199. Allegato 3 - paragrafo 2

Servizio	Qp ren [kWh]	Qp nren [kWh]	Qp tot [kWh]
Riscaldamento	*41793,16*	*1321,21*	*43114,37*
Acqua calda sanitaria	*5184,62*	*56,28*	*5240,90*
Raffrescamento	*9113,05*	*0,00*	*9113,05*
TOTALI	*56090,83*	*1377,48*	*57468,32*

% copertura = [(*56090,83*) / (*57468,32*)] * 100 = *97,60*

Dettagli – Copertura acqua sanitaria da fonte rinnovabile :

Riferimento: DLgs 8.11.2021 n. 199. Allegato 3 - paragrafo 2

Servizio	Qp ren [kWh]	Qp nren [kWh]	Qp tot [kWh]
Acqua calda sanitaria	*5184,62*	*56,28*	*5240,90*

% copertura = [(*5184,62*) / (*5240,90*)] * 100 = *98,93*

Dettagli – Verifica potenza elettrica installata :

Riferimento: DLgs 8.11.2021 n. 199. Allegato 3 - paragrafo 3

Superficie in pianta a livello del terreno	= *6280,00*	m^2
K	= *0,050*	
Potenza minima K * S	= *314,00*	kW

Dettagli – Fabbisogni energetici servizio Riscaldamento:

Qp,ren = 41793,16 kWh

Qp,nren = 1321,21 kWh

Qp,tot = 43114,37 kWh

Qp,x =∑m[∑i(Edel,ter,gen,i * fpx,gen,i) + Wdel,CG,ren + Wdel,CG,nren + Wdel,CG,tot + (Wdel,Fv * fpx) + (Qel,gross * fpx) + (Qsol *fpx) + (Qeres* fpx) – (Qel,surplus,CG * fpx) – (Qel,surplus,FV *fpx)]

	Gen [kWh]	Feb [kWh]	Mar [kWh]	Apr [kWh]	Mag [kWh]	Giu [kWh]	Lug [kWh]	Ago [kWh]	Set [kWh]	Ott [kWh]	Nov [kWh]	Dic [kWh]	fp ren	fp nren	fp tot
Edel,ter,z1,g1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,47	1,95	2,42
Wdel,CG,ren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,nren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,tot	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,fv	4578,25	4608,76	2704,38	831,12	0,00	0,00	0,00	0,00	0,00	315,92	2436,18	3518,11	1,00	0,00	1,00
Qel,gross	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	677,54	0,47	1,95	2,42
Qsol	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	0,00	1,00
Qeres	8932,22	4826,74	1571,26	417,78	0,00	0,00	0,00	0,00	0,00	341,55	4073,11	9239,32	1,00	0,00	1,00
Qel,surplus,CG	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Qel,surplus,FV	428,58	2555,83	2169,06	711,57	0,00	0,00	0,00	0,00	0,00	228,32	826,62	0,00	1,00	0,00	1,00

Legenda simboli

Edel,ter,z1,g1	Energia termica consegnata Pompa di calore - secondo UNI/TS 11300-4 ECT1Engine.ZonaClimatizzata-Zona uffici
Wdel,CG,ren	Energia elettrica in situ da cogenerazione rinnovabile
Wdel,CG,nren	Energia elettrica in situ da cogenerazione non rinnovabile
Wdel,CG,tot	Energia elettrica in situ da cogenerazione totale
Wdel,fv	Energia elettrica in situ da Fotovoltaico, inclusa eccedenza
Qel,gross	Energia elettrica prelevata dalla rete
Qsol	Energia termica proveniente da solare termico utilizzata nel mese
Qeres	Energia termica proveniente da pompa di calore (Eres)
Qel,surplus,CG	Energia prodotta da CG e non consumata nel mese
Qel,surplus,FV	Energia prodotta da FV e non consumata nel mese

Dettagli – Fabbisogni energetici servizio Acqua calda sanitaria:

Qp,ren = 5184,62 kWh

Qp,nren = 56,28 kWh

Qp,tot = 5240,90 kWh

Qp,x =∑m[∑i(Edel,ter,gen,i * fpx,gen,i) + Wdel,CG,ren + Wdel,CG,nren + Wdel,CG,tot + (Wdel,Fv * fpx) + (Qel,gross * fpx) + (Qsol *fpx) + (Qeres* fpx) – (Qel,surplus,CG * fpx) – (Qel,surplus,FV *fpx)]

	Gen [kWh]	Feb [kWh]	Mar [kWh]	Apr [kWh]	Mag [kWh]	Giu [kWh]	Lug [kWh]	Ago [kWh]	Set [kWh]	Ott [kWh]	Nov [kWh]	Dic [kWh]	fp ren	fp nren	fp tot
Edel,ter,z1,g1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,47	1,95	2,42
Wdel,CG,ren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,nren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,tot	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,fv	197,55	337,28	740,87	904,26	799,25	659,00	610,94	572,66	608,17	463,98	232,29	149,86	1,00	0,00	1,00
Qel,gross	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	28,86	0,47	1,95	2,42
Qsol	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	1,00	0,00	1,00
Qeres	325,38	289,65	313,26	298,46	299,62	284,09	290,98	293,26	290,84	306,14	307,55	325,23	1,00	0,00	1,00
Qel,surplus,CG	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Qel,surplus,FV	18,49	187,04	594,22	774,19	686,72	563,97	518,97	474,98	496,80	335,32	78,82	0,00	1,00	0,00	1,00

Legenda simboli

Edel,ter,z1,g1	Energia termica consegnata Pompa di calore - secondo UNI/TS 11300-4 1-Zona uffici
Wdel,CG,ren	Energia elettrica in situ da cogenerazione rinnovabile
Wdel,CG,nren	Energia elettrica in situ da cogenerazione non rinnovabile
Wdel,CG,tot	Energia elettrica in situ da cogenerazione totale
Wdel,fv	Energia elettrica in situ da Fotovoltaico, inclusa eccedenza
Qel,gross	Energia elettrica prelevata dalla rete
Qsol	Energia termica proveniente da solare termico utilizzata nel mese
Qeres	Energia termica proveniente da pompa di calore (Eres)
Qel,surplus,CG	Energia prodotta da CG e non consumata nel mese
Qel,surplus,FV	Energia prodotta da FV e non consumata nel mese

Dettagli – Fabbisogni energetici servizio Raffrescamento:

Qp,ren = 9113,05 kWh

Qp,nren = 0,00 kWh

Qp,tot = 9113,05 kWh

Qp,x =∑m[∑i(Edel,ter,gen,i * fpx,gen,i) + Wdel,CG,ren + Wdel,CG,nren + Wdel,CG,tot + (Wdel,Fv * fpx) + (Qel,gross * fpx) + (Qsol *fpx) + (Qeres* fpx) – (Qel,surplus,CG * fpx) – (Qel,surplus,FV *fpx)]

	Gen [kWh]	Feb [kWh]	Mar [kWh]	Apr [kWh]	Mag [kWh]	Giu [kWh]	Lug [kWh]	Ago [kWh]	Set [kWh]	Ott [kWh]	Nov [kWh]	Dic [kWh]	fp ren	fp nren	fp tot
Edel,ter,z1,g1	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,47	1,95	2,42
Wdel,CG,ren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,nren	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,CG,tot	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	-	-	-
Wdel,fv	0,00	0,08	65,81	1180,40	8105,82	14223,39	17483,72	13310,10	4342,49	144,64	0,12	0,00	1,00	0,00	1,00
Qel,gross	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,47	1,95	2,42
Qel,surplus,CG	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00	0,00
Qel,surplus,FV	0,00	0,04	52,78	1010,61	6964,50	12172,25	14851,76	11039,74	3547,26	104,53	0,04	0,00	1,00	0,00	1,00

Legenda simboli

Edel,ter,z1,g1	Energia termica consegnata Pompa di calore - secondo UNI/TS 11300-3 1-Zona uffici
Wdel,CG,ren	Energia elettrica in situ da cogenerazione rinnovabile
Wdel,CG,nren	Energia elettrica in situ da cogenerazione non rinnovabile
Wdel,CG,tot	Energia elettrica in situ da cogenerazione totale
Wdel,fv	Energia elettrica in situ da Fotovoltaico, inclusa eccedenza
Qel,gross	Energia elettrica prelevata dalla rete
Qel,surplus,CG	Energia prodotta da CG e non consumata nel mese
Qel,surplus,FV	Energia prodotta da FV e non consumata nel mese

ATTESTATO DI PRESTAZIONE ENERGETICA DEGLI EDIFICI

CODICE IDENTIFICATIVO: VALIDO FINO AL: 02/07/2031

APE 2015

DATI GENERALI

Destinazione d'uso

- [ ] Residenziale
- [x] Non residenziale

Classificazione D.P.R. 412/93: **E.2**

Oggetto dell'attestato

- [x] Intero edificio
- [ ] Unità immobiliare
- [ ] Gruppo di unità immobiliari

Numero di unità immobiliari di cui è composto l'edificio: **1**

- [x] Nuova costruzione
- [ ] Passaggio di proprietà
- [ ] Locazione
- [ ] Ristrutturazione importante
- [ ] Riqualificazione energetica
- [ ] Altro:

Dati identificativi

FOTO EDIFICIO

Regione : **LOMBARDIA**
Comune : **Siziano (PV)**
Indirizzo : **Via Liguria**
Piano : **PT - P1**
Interno :
Coordinate GIS : **45,353165 N - 9,310174 E**

Zona climatica : **E**
Anno di costruzione : **2026**
Superficie utile riscaldata (m²) : **1663,31**
Superficie utile raffrescata (m²) : **1199,52**
Volume lordo riscaldato (m³) : **10379,24**
Volume lordo raffrescato (m³) : **7056,99**

Comune catastale									Sezione				Foglio				Particella			
Subalterni	da		a			da		a			da		a			da		a		
Altri subalterni																				

Servizi energetici presenti

- [x] Climatizzazione invernale
- [x] Climatizzazione estiva
- [x] Ventilazione meccanica
- [x] Prod. acqua calda sanitaria
- [x] Illuminazione
- [ ] Trasporto di persone o cose

PRESTAZIONE ENERGETICA GLOBALE E DEL FABBRICATO

La sezione riporta l'indice di prestazione energetica globale non rinnovabile in funzione del fabbricato e dei servizi energetici presenti, nonché la prestazione energetica del fabbricato, al netto del rendimento degli impianti presenti.

Prestazione energetica del fabbricato

INVERNO	ESTATE

Prestazione energetica globale

Più efficiente

A4 A3 A2 A1 B C D E F G

Meno efficiente

EDIFICIO A ENERGIA QUASI ZERO

CLASSE ENERGETICA

A4

1,91 kWh/m²anno

Riferimenti

Gli immobili simili avrebbero in media la seguente classificazione:

Se nuovi: A4 (4,16)

Se esistenti: -

PRELIMINARY

PRESTAZIONE ENERGETICA DEGLI IMPIANTI E CONSUMI STIMATI

La sezione riporta l'indice di prestazione energetica rinnovabile e non rinnovabile, nonché una stima dell'energia consumata annualmente dall'immobile secondo un uso standard.

Prestazioni energetiche degli impianti e stima dei consumi di energia

	FONTI ENERGETICHE UTILIZZATE	Quantità annua consumata in uso standard (specificare unità di misura)	Indici di prestazione energetica globali ed emissioni
X	Energia elettrica da rete	1630 kWh	Indice della prestazione energetica non rinnovabile EPgl,nren kWh/m² anno 1,91
	Gas naturale		
	GPL		
	Carbone		
	Gasolio		
	Olio combustibile		Indice della prestazione energetica rinnovabile EPgl,ren kWh/m² anno 71,73
	Biomasse solide		
	Biomasse liquide		
	Biomasse gassose		
X	Solare fotovoltaico	85516 kWh	
	Solare termico		Emissioni di CO_2 kg/m² anno 0
	Eolico		
	Teleriscaldamento		
	Teleraffrescamento		
	Altro		

RACCOMANDAZIONI

La sezione riporta gli interventi raccomandati e la stima dei risultati conseguibili, con il singolo intervento o con la realizzazione dell'insieme di essi, esprimendo una valutazione di massima del potenziale di miglioramento dell'edificio o immobile oggetto dell'attestato di prestazione energetica.

RIQUALIFICAZIONE ENERGETICA E RISTRUTTURAZIONE IMPORTANTE

INTERVENTI RACCOMANDATI E RISULTATI CONSEGUIBILI

Codice	TIPO DI INTERVENTO RACCOMANDATO	Comporta una Ristrutturazione importante	Tempo di ritorno dell'investimento anni	Classe Energetica raggiungibile con l'intervento ($EP_{gl,nren}$ kWh/m² anno)	CLASSE ENERGETICA raggiungibile se si realizzano tutti gli interventi raccomandati
R EN 1		no	0,00	A4 0,00	A4 0,00 kWh/m² anno
R EN					
R EN					
R EN					
R EN					
R EN					

PRELIMINARY

ALTRI DATI ENERGETICI GENERALI

Energia esportata	277989,51 kWh/anno	Vettore energetico: Energia elettrica

ALTRI DATI DI DETTAGLIO DEL FABBRICATO

V – Volume riscaldato	10379,24	m^3
S – Superficie disperdente	3485,09	m^2
Rapporto S/V	0,34	
$EP_{H,nd}$	70,06	kWh/m^2 anno
$A_{sol,est}/A_{sup\ utile}$	0,0377	-
Y_{IE}	0,0096	W/m^2K

DATI DI DETTAGLIO DEGLI IMPIANTI

Servizio energetico	Tipo di impianto	Anno di installazione	Codice catasto regionale impianti termici	Vettore energetico utilizzato	Potenza Nominale kW	Efficienza media stagionale		EPren	EPnren
Climatizzazione invernale	HP elettrica aria-aria	2026		Energia elettrica da rete	49,30	270,3	η_H	25,13	0,79
Climatizzazione estiva	HP elettrica aria-aria	2026		Energia elettrica da rete	120,70	258,3	η_C	5,48	0,00
Prod. acqua calda sanitaria	HP elettrica aria-acqua	2026		Energia elettrica da rete	4,65	72,9	η_W	3,12	0,03
Impianti combinati									
Produzione da fonti rinnovabili	Impianto fotovoltaico	2026		Solare fotovoltaico	320,00	0,0		0,00	0,00
Ventilazione meccanica	Ventilatori	2026		Energia elettrica da rete	4,88	0,0		8,50	0,23
Illuminazione		2026		Energia elettrica da rete	24,25	0,0		29,50	0,85
Trasporto di persone o cose									

PRELIMINARY

Legal Office:
DBA S.p.A.
Santo Stefano di Cadore
32045, Santo Stefano di Cadore (BL)
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DBA S.p.A.
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20127, Milan
Italy
+39 0422 693511
dbaprogetti@pec.dbagroup.it
www.dbagroup.it

COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:

STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-AZ-XX-CA-M-50001

13038001

Title:

Calculation
Roomlist
Whole Building

PD0 - RIBA 3	**ITM**	**50001**

Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - Roomlist - Whole Building
Document ID	MIL07-DBA-AZ-XX-CA-M-50001
Date	7-11-2025
Revision	P01

Office area

Room list														Mechanical smoke extraction system		Indoor design criteria		Cooling/Heating					Comments
Level	Building section	Description		Area	Heigth	ASHRAE 62.1			Occupancy	Personalized	Fresh air	Extract air	System	YES/NO	Type	Temperatures		Heating	Cooling	System		Maximum loads [kW]	
				m^2	m	L/s/p	L/s/m^2	m^2/p	person	ACH	m^3/h	m^3/h				Summer	Winter	Yes/No	Yes/No	Description	Cooling	Heating	
Ground Floor (00)	AF	Fire Command Room / Locale Controllo Antincendio	FCR01	13,6	6,4					0,5	50	50	AF-AHU-1	NO		-	10,0±1,0°C	Yes	No	Electric radiator		0,5	
Ground Floor (00)	AF	Water Room / Ingresso Acqua	WAT01	14,0	6,4					0,5	250	250	AF-AHU-1	NO		-	10,0±1,0°C	Yes	No	Electric radiator		0,5	
Ground Floor (00)	AF	Sprinkler Room / Locale Sprinkler	SPK01	18,88	6,4					0,5	60		AF-AHU-1	NO		-	10,0±1,0°C	Yes	No	Electric radiator		0,8	Air return from COR01
Ground Floor (00)	AF	Electrical Room / Locale Elettrico	ER01	20,21	6,4					0,5	70		AF-AHU-1	NO		25 °C	25 °C	No	Yes	DX Units			Overpressure through COR01
Ground Floor (00)	AF	Shaft / Cavedio	SHF01	7,93	6,4					0,5	50	50	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	No	No	-			
Ground Floor (00)	AF	Break room / Area break	BRK02	30,62	3,0	2,5	0,6	0,5	16		220	220	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	3,3	1	
Ground Floor (00)	AF	SOC Manager Office / Ufficio Manager SOC	SOC03	13,13	3,0	2,5	0,3	0,05	1		50	50	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1,3	0,6	
Ground Floor (00)	AF	Security Operation Center / Ufficio Operativo Sicurezza	SOC02	39,04	3,0	2,5	0,3	0,05	4		80	80	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	3,1	1,9	
Ground Floor (00)	AF	SOC storage / Ripostiglio SOC	SOC01	11,66	6,4	2,5	0,3	0,02	1		50	50	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	0,7	0,7	
Ground Floor (00)	AF	Corridor / Corridoio	COR01	141,15	6,4						220	320	AF-AHU-1	NO		-	-	No	No	-			Air supply for RES01 and JAN01 Air return for SPK01, ER01, ER and MMR01
Ground Floor (00)	AF	Lobby / Atrio	LOB01	49,27	6,4	2,5	0,3	0,1	5		100	100	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units and VRF air curtains	6,2	1,8	
Ground Floor (00)	AF	Freight elevator / Montacarichi	EVR02	15,4	12,4						-	-		NO		-	-	No	No	-			
Ground Floor (00)	AF	Shaft / Cavedio	SHF02	5,89	6,4					0,5	50	50	AF-AHU-1	NO		-	-	No	No	-			
Ground Floor (00)	AF	Storage / Magazzino	STO01	41,33	6,4	2,5	0,3	0,02	1		140	140	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	0,7	1	
Ground Floor (00)	AF	Men's toilet / Servizi igienici uomini	RES03	14,25	3,0		12,5		3		150	150	AF-TEF-1	NO		-	-	No	No	-			Air supply located in the washbasin area and air extraction located in the WC area
													AF-AHU-1										
Ground Floor (00)	AF	Women's toilet / Servizi igienici donne	RES02	14,2	3,0		12,5		3		150	150	AF-TEF-1	NO		-	-	No	No	-			Air supply located in the washbasin area and air extraction located in the WC area
													AF-AHU-1										
Ground Floor (00)	AF	Accessible toilet / Bagno disabili	RES01	4,86	3,0		12,5		1			50	AF-TEF-1	NO		-	-	No	No	-			Air supply from COR01
Ground Floor (00)	AF	Janitorial / Locale pulizie	JAN01	9	3,0		5					170	AF-TEF-1	NO		-	-	No	No	-			Air supply from COR01
Ground Floor (00)	AF	Internal Staircase / Scala interna	STR01	13,77	16,2						-	-		NO		-	-	No	No	-			
Ground Floor (00)	AF	Freight elevator / Montacarichi	EVR01	15,4	16,2						-	-		NO		-	-	No	No	-			
Ground Floor (00)	AF	Vestibule / Disimpegno	VST01	2,6	3,0						50		AF-AHU-1	NO		-	-	No	No	-			Air supply for RES04
Ground Floor (00)	AF	Unisex toilet / Bagno unisex	RES04	3,5	3,0		12,5		1			50	AF-TEF-1	NO		-	-	No	No	-			Air supply from VST01
Ground Floor (00)	AF	Vestibule / Disimpegno	VST02	3,7	3,0						50		AF-AHU-1	NO		-	-	No	No	-			Air supply for RES05
Ground Floor (00)	AF	Accessible toilet / Bagno disabili	RES05	5,19	3,0		12,5		1			50	AF-TEF-1	NO		-	-	No	No	-			Air supply from VST02
Ground Floor (00)	AF	Conference Room / Sala conferenze	CON01	47,1	3,0	2,5	0,3	0,5	14		180	130	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	8,4	2	Air supply also for CON02
Ground Floor (00)	AF	Conference Room Storage / Magazzino sala conferenze	CON02	2,38	3,0	2,5	0,3	0,02	1			50	AF-AHU-1	NO		-	-	No	No	-			Air supply from COR01
Ground Floor (00)	AF	Break room / Area Break	BRK01	23,13	3,0	2,5	0,6	0,5	5		160	160	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1,7	1,3	
Ground Floor (00)	AF	Comunication Equipment Room / Sala Apparati Telecomunicazione	CER01	35,3	6,4					0,5	120		AF-AHU-1	NO		27 °C	27 °C	No	Yes	CRAHs on crtical system			Overpressure through COR01
Ground Floor (00)	AF	POE / POE	POE01	19,76	6,4					0,5	120	120	AF-AHU-1	NO		25 °C	25 °C	No	Yes	DX Units			POE02 and MMR02 ventilated logheter because they are devided by a mesh wall. Overpressure through COR02.
Ground Floor (00)	AF	MMR / MMR	MMR01	16,34	6,4																		
Ground Floor (00)	AF	Electrical Room / Locale Elettrico	ER02	21,92	6,4					0,5	70		AF-AHU-1	NO		25 °C	25 °C	No	Yes	DX Units			Overpressure through COR01
Ground Floor (00)	AF	Storage / Magazzino	STO02	61,63	6,4	2,5	0,3	0,02	2		200	200	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1	1,5	
Ground Floor (00)	AF	Staging-Receiving Area / Area Stoccaggio Temporaneo	STG01	64,74	6,4	5	0,6	0,02	2		180	180	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1,1	1,8	
Ground Floor (00)	AF	Asset Management Office / Ufficio Asset Management	OFF01	13,59	3,0	2,5	0,3	0,05	1		50	50	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	0,8	0,7	
Ground Floor (00)	AF	Loading-Unloading area / Locale Carico-Scarico	SHP01	122,23	6,4	5	0,6	0,02	3		320	320	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units and electrical air curtains	2,3	4,8	
First Floor (01)	AF	Storage / Magazzino	STO12	48,27	5	2,5	0,3	0,02	1		130	130	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	0,9	1,6	
First Floor (01)	AF	Shaft / Cavedio	SHF01	7,93	5					0,5	50	50	AF-AHU-1	NO		-	-	No	No	-			
First Floor (01)	AF	Storage / Magazzino	STO11	52,51	5	2,5	0,3	0,02	2		140	140	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1	1,5	
First Floor (01)	AF	Office / Ufficio	OFF13	103,64	3	2,5	0,3	0,05	6		170	170	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	12,7	5,5	
First Floor (01)	AF	Office / Ufficio	OFF12	119,08	3	2,5	0,3	0,05	6		190	190	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	15,1	4,8	
First Floor (01)	AF	Corridor / Corridoio	COR11	123,66	5,2						170		AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	No	No	-			Air supply for RES11 and JAN11
First Floor (01)	AF	Shaft / Cavedio	SHF02	5,59	5					0,5	50	50	AF-AHU-1	NO		-	-	No	No	-			
First Floor (01)	AF	Changing room / Spogliatoio	CHG11	18,91	3		10		3			150	AF-TEF-1	NO		-	20,0±1,0°C	Yes	No	Electric radiator		0,4	Air supply located in the locker area and air extraction located in the shower area
											150		AF-AHU-1										
First Floor (01)	AF	Changing room / Spogliatoio	CHG12	19,2	3		10		3			150	AF-TEF-1	NO		-	20,0±1,0°C	Yes	No	Electric radiator		0,4	Air supply located in the locker area and air extraction located in the shower area
											150		AF-AHU-1										
First Floor (01)	AF	Accessible toilet / Bagno disabili	RES11	4,77	3		12,5		1			50	AF-TEF-1	NO		-	-	No	No	-			Air supply from COR11
First Floor (01)	AF	Women's toilet / Servizi igienici donne	RES12	13,66	3		12,5		3			150	AF-TEF-1	NO		-	-	No	No	-			Air supply located in the washbasin area and air extraction located in the WC area
											150		AF-AHU-1										
First Floor (01)	AF	Men's toilet / Servizi igienici uomini	RES13	13,71	3		12,5		3			150	AF-TEF-1	NO		-	-	No	No	-			Air supply located in the washbasin area and air extraction located in the WC area
											150		AF-AHU-1										
First Floor (01)	AF	Janitorial / Locale pulizie	JAN11	6,17	3		5					120	AF-TEF-1	NO		-	-	No	No	-			Air supply from COR11
First Floor (01)	AF	Safe waiting area / Spazio calmo	STR02	2,15	5,1						-	-		NO		-	-	No	No	-			
First Floor (01)	AF	Vestibule / Disimpegno	VST11	2,08	5,2						-	-		NO		-	-	No	No	-			
First Floor (01)	AF	Storage / Magazzino	STO13	141,93	5,1	2,5	0,3	0,02	3		370	370	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	1,9	2,8	
First Floor (01)	AF	Office / Ufficio	OFF11	214,19	3	2,5	0,3	0,05	11		340	340	AF-AHU-1	NO		26,0±1,0°C	20,0±1,0°C	Yes	Yes	VRF Fan coil units	23,1	8,3	

Ventilation system of office area	Fresh air	Extract air	System
	m3/h	m3/h	
Dedicated outdoor system	5400	4010	AF-AHU-1
Air extraction system		1390	AF-TEF-1
Overall air flow	5400	5400	

Critical area

Room list														Smoke extraction system		Indoor design criteria		Cooling/Heating					Comments
Level	Building section	Description		Area	Heigth	ASHRAE 62.1			Occupancy		Fresh air	Extract air	System	YES/NO	Type	Temperatures		Heating	Cooling	System	Maximum loads [kW]		
				m^2	m	L/s/p	L/s/m^2	m^2/p	person	ACH	m^3/h	m^3/h				Summer	Winter	Yes/No	Yes/No	Description	Cooling	Heating	
Ground Floor (00)		Shaft / Cavedio	SHFD	14,59	6,3					0,5	50	50	A1-AHU-1	NO		-	-	No	No	-			
Ground Floor (00)		Shaft / Cavedio	SHFC	2,1	6,2						_	_	A1-AHU-1	NO		-	-						
Ground Floor (00)		Data Hall / Sala Dati	DH01	1596,03	4,4	2,5	0,3	0,04	64		1400		A1-AHU-1	YES	Ducted smoke extraction system	27 °C	27 °C	No	Yes	FANWALLs on crtical system			Overpressure through COR02 The area of the data hall consider also the area of the mechanical gallery
											1400		A2-AHU-1										
Ground Floor (00)		Mechanical gallery / Galleria meccanica	MEC01	339,76	6,1						_	_		YES	Ducted smoke extraction system	38 °C	38 °C	No	Yes	FANWALLs on crtical system			
Ground Floor (00)		Shaft / Cavedio	SHFE	14,32	6,3					0,5	50	50	A1-AHU-1	NO		-	-	No	No	-			
Ground Floor (00)		Shaft / Cavedio	SHFF	2	6,2						_	_		NO		-	-						
Ground Floor (00)		POE / POE	POE02	18,83	6,3					0,5	100		A1-AHU-1	NO		25 °C	25 °C	No	Yes	DX Units			POE02 and MMR02 ventilated togheter because they are devided by a mesh wall. Overpressure through COR02.
Ground Floor (00)		MMR / MMR	MMR02	10,44	6,3																		
Ground Floor (00)		Comunication Equipment Room / Sala Apparati Telecomunicazione	CER02	26,85	6,3					0,5	90		A1-AHU-1	NO		27 °C	27 °C	No	Yes	CRAH on crytical system			
Ground Floor (00)		Sprinkler Room / Locale Sprinkler	SPK02	16,07	6,2					0,5	50		A1-AHU-1	NO		-	10,0±1,0°C	Yes	No	Electric radiator		0,6	Ai return from COR02
Ground Floor (00)		Corridor / Corridoio	COR02	583,26	6,2							1640	A1-AHU-1	NO		-	-	No	No	-			Air return from DH01, SPK02, POE02, MMR02 and CER02
												1400	A2-AHU-1	NO		-	-	No	No	-			Air return from DH01
Ground Floor (00)		Data Hall / Sala Dati	DH02	1587,74	4,4	2,5	0,3	0,04	64		1400		A1-AHU-1	YES	Ducted smoke extraction system	-	-	No	No	-			
											1400		A2-AHU-1			-	-	No	No	-			
Ground Floor (00)		Mechanical gallery / Galleria meccanica	MEC02	331,79	6,1						_	_		YES	Ducted smoke extraction system	38 °C	38 °C	No	Yes	FANWALLs on crtical system			
Ground Floor (00)		Corridor / Corridoio	COR03	420,55	6,2							1400	A1-AHU-1	NO		-	-	No	No	-			Air return from DH02
												1400	A2-AHU-1	NO				No	No	-			Air return from DH02
Ground Floor (00)		Shaft / Cavedio	SHFK	3,34	6,2					0,5	50	50	A2-AHU-1	NO		-	-	No	No	-			
Ground Floor (00)		Shaft / Cavedio	SHFJ	14,32	6,3					0,5	50	50	A2-AHU-1	NO		-	-	No	No				
Ground Floor (00)		Shaft / Cavedio	SHFH	14,32	6,3					0,5	50	50	A2-AHU-1	NO		-	-	No	No	-			
Ground Floor (00)		Shaft / Cavedio	SHFI	2	6,2						_	_		NO		-	-	No	No	-			
Ground Floor (00)		Shaft / Cavedio	SHFG	2	6,2						_	_		NO		-	-	No	No	-			

Ventilation system of critical phase 1 area	Fresh air	Extract air	System
	m3/h	m3/h	
Dedicated outdoor system	3140	3140	A1-AHU-1
Dedicated outdoor system	2950	2950	A2-AHU-1
Overall air flow	6090	6090	

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:
STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-AZ-XX-CA-M-55050

13038001

Title:
Calculation
PUE
Annual and Peak

PD0 - RIBA 3	**ITM**	**55050**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

Rev	EDITED	CHECKED	APPROVED	DATE	DESCRIPTION
P01	LG	GR	SB	07.11.2025	S4 - RIBA 3

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Project	MIL07
Document:	Calculation - PUE - Annual and Peak
Document ID	MIL07-DBA-AZ-XX-CA-M-55050
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Phase 1 6 MW - Peak PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Number of DM	1	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
IT power consumed			
IT load	6000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	6000	kW	
Number of DM	1	[-]	
IT load per DM	6000	kW	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	20	kW	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	80	kW	
Total IT power	**6100**	**kW**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling	8	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	218	kW	Capacity 915 kW
Chiller pump consumption	20	kW	
Total chillers consumptions, pumps included	1906	kW	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	1	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	378	kW	
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	4	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	32	kW	
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	5	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	11	kW	
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	4	kW	
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	80	kW	
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	5	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	15	kW	
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	1	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	12	kW	
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	12	kW	
Other critical mechanical loads	30	kW	
Non critical mechanical loads	150	kW	
Total mechanical systems consumptions	**2630**	**kW**	
Electrical systems losses			
UPS losses	3,20%	[-]	
	230	kW	UPS for IT load (2*3*1000kW), mechanical pumps and air handling units for continous cooling (1*4*300kW)
IT distribution losses	1,00%	[-]	
	61	kW	
Mechanical distribution losses	1,00%	[-]	
	26	kW	
MV transformers losses	1,10%	[-]	
	100	kW	
Total electrical losses	**417**	**kW**	
Peak PUE calculation			
Total IT power	6100	kW	
Total power consumed	9148	kW	
Peak PUE	**1,500**		

Client:	STACK INFRASTRUCTURE
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Phase 1 6 MW - Annual PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	6000	kW	
Number of DM	1	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
Calculation hours	8760	h	
IT power consumed (assumed static)			
IT load	6000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	52560000	kWh	
Number of DM	1	[-]	
IT load per DM	52560000	kWh	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	175200	kWh	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	700800	kWh	
Total IT power	**53436000**	**kWh**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling and glycol loop	8	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	456443	kWh	Capacity 915 kW
Chiller pump consumption	20	kW	Assumed static
Total chillers consumptions, pumps included	5053143	kWh	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	1	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	3311280	kWh	Assumed static
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	4	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	280320	kWh	Assumed static
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	5	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	96360	kWh	Assumed static
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	35040	kWh	Assumed static
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	700800	kWh	Assumed static
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	5	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	131400	kWh	Assumed static
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	1	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	105120	kWh	Assumed static
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	105120	kWh	Assumed static
Other critical mechanical loads	262800	kWh	Assumed static
Non critical mechanical loads	1314000	kWh	Assumed static
Total mechanical systems consumptions	**11395383**	**kWh**	
Electrical systems losses (assumed static)			
UPS losses	3,20%	[-]	
	2018304	kWh	UPS for IT load (2*3*1000kW), mechanical pumps and air handling units for continous cooling (1*4*300kW)
IT distribution losses	1,00%	[-]	
	534360	kWh	
Mechanical distribution losses	1,00%	[-]	
	113954	kWh	
MV transformers losses	1,10%	[-]	
	742478	kWh	
Total electrical losses	**3409096**	**kWh**	
Annual PUE calculation			
Total IT power	53436000	kWh	
Total power consumed	68240479	kWh	
Annual PUE	**1,277**		

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Phase 2 12 MW - Peak PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Number of DM	2	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
IT power consumed			
IT load	12000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	12000	kW	
Number of DM	2	[-]	
IT load per DM	6000	kW	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	20	kW	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	80	kW	
Total IT power	**12100**	**kW**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling	14	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	252	kW	Capacity 1045 kW
Chiller pump consumption	20	kW	
Total chillers consumptions, pumps included	3805	kW	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	2	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	756	kW	
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	7	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	56	kW	
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	8	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	18	kW	
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	4	kW	
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	80	kW	
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	8	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	24	kW	
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	2	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	24	kW	
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	12	kW	
Other critical mechanical loads	40	kW	
Non critical mechanical loads	150	kW	
Total mechanical systems consumptions	**4968**	**kW**	
Electrical systems losses			
UPS losses	3,20%	[-]	
	451	kW	UPS for IT load (2*6*1000kW), mechanical pumps and air handling units for continous cooling (1*7*300kW)
IT distribution losses	1,00%	[-]	
	121	kW	
Mechanical distribution losses	1,00%	[-]	
	50	kW	
MV transformers losses	1,10%	[-]	
	195	kW	
Total electrical losses	**816**	**kW**	
Peak PUE calculation			
Total IT power	12100	kW	
Total power consumed	17885	kW	
Peak PUE	**1,478**		

Client:	STACK INFRASTRUCTURE
Project	MIL07
Document:	Calculation - PUE - Annual and Peak
Document ID	MIL07-DBA-AZ-XX-CA-M-55050
Date	7-11-2025
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Phase 2 12 MW - Annual PUE

Description	[Value]	[UM]	Remarks
Design Data			
Design IT load	12000	kW	
Number of DM	2	[-]	
Design IT load per DM	6000	kW	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	
Calculation hours	8760	h	
IT power consumed (assumed static)			
IT load	12000	kW	
Percentage of building load	100,00%	[-]	
Actual IT load	105120000	kWh	
Number of DM	2	[-]	
IT load per DM	52560000	kWh	
MMR load	10	kW	
Number of MMR	2	[-]	
Total MMR load	175200	kWh	
CER load	40	kW	
Number of CER	2	[-]	
Total CER load	700800	kWh	
Total IT power	**105996000**	**kWh**	
Mechanical systems consumptions			
Air cooled chillers with free-cooling and glycol loop	14	[-]	N+2; failure capacity: 1220 kW
Chiller consumption at design conditions in N+2	537622	kWh	Capacity 1045 kW
Chiller pump consumption	20	kW	Assumed static
Total chillers consumptions, pumps included	9979512	kWh	
Fan Wall units per DM	14	[-]	N+2; failure capacity: 540 kW
DM number	2	[-]	
DM Fan Wall consumption in N+2	27	kW	Capacity 463 kW
Total DM Fan Wall consumptions	6622560	kWh	Assumed static
CRAH units per LV1 electrical pod	2	[-]	N+1; failure capacity: 105 kW
LV1 electrical pod number	7	[-]	
LV1 electrical pod CRAH consumption in N+1	4	kW	Capacity 53 kW
Total LV1 electrical pod CRAH consumptions	490560	kWh	Assumed static
CRAH units per LV2 electrical pod	2	[-]	N+1; failure capacity: 50 kW
LV2 electrical pod number	8	[-]	
LV2 electrical pod CRAH consumption in N+1	1,1	kW	Capacity 25 kW
Total LV2 electrical pod CRAH consumptions	154176	kWh	Assumed static
CRAH units per CER	2	[-]	N+1; failure capacity: 40 kW
CER number	2	[-]	
CER CRAH consumption in N+1	1	kW	Capacity 20 kW
Total CER CRAH consumptions	35040	kWh	Assumed static
Critical DOAS units	2	[-]	
DOAS consumption	40	kW	
Total DOAS consumptions	700800	kWh	Assumed static
DX units per Battery	2	[-]	N+1; failure capacity: 5kW
Battery number	8	[-]	
Battery DX unit consumption	1,5	kW	
Total Battery DX units consumptions	210240	kWh	Assumed static
DX units per Electrical Corridor	4	[-]	N+1; failure capacity: 10kW
Electrical Corridor number	2	[-]	
Electrical Corridor DX unit consumption	3	kW	
Total Electrical Corridor DX units consumptions	210240	kWh	Assumed static
DX units per MMR	2	[-]	N+1; failure capacity: 10kW
MMR number	2	[-]	
MMR DX unit consumption	3	kW	
Total MMR DX units consumptions	105120	kWh	Assumed static
Other critical mechanical loads	350400	kWh	Assumed static
Non critical mechanical loads	1314000	kWh	Assumed static
Total mechanical systems consumptions	**20172648**	**kWh**	
Electrical systems losses (assumed static)			
UPS losses	3,20%	[-]	
	3952512	kWh	UPS for IT load (2*6*1000kW), mechanical pumps and air handling units for continous cooling (1*7*300kW)
IT distribution losses	1,00%	[-]	
	1059960	kWh	
Mechanical distribution losses	1,00%	[-]	
	201726	kWh	
MV transformers losses	1,10%	[-]	
	1445211	kWh	
Total electrical losses	**6659410**	**kWh**	
Annual PUE calculation			
Total IT power	105996000	kWh	
Total power consumed	132828058	kWh	
Annual PUE	**1,253**		

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COMUNE DI SIZIANO

Principal:

STACK INFRASTRUCTURE

Project:
STACK INFRASTRUCTURE - MIL 07

MIL07-DBA-AZ-XX-CA-M-55051

13038001

Title:
Calculation
ASHRAE 90.4
Mechanical

PD0 - RIBA 3	**ITM**	**55051**	
Prog.	**D. De Bettin** **S. Busetti**	**PM**	**A. Masiero**
BIMM	**S. Di Biase**	**BIMC**	**R. Sodano**

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Project	MIL07
Document:	Calculation- ASHRAE 90.4 - Mechanical
Document ID	MIL07-DBA-AZ-XX-CA-M-55051
Date	7-11-2025
Revision	P01

MLC calculation, ref. ASHREA 90.4-2022 Section 6, with Addendum g

$$Annualized\ MLC = \frac{\sum \text{MechE for 25\%, 50\%, 75\%, 100\% ITE design}}{2.5 \times 8760 \text{ hours} \times ITE\ design\ power} \qquad (6.5)$$

Design Data

Description	[Value]	[UM]	Remarks
Design IT load	12000	kW	
Calculation hours	8760	h	
Summer ambient design temperature	43	°C	ASHRAE 2025 extreme climate condition n=20 (38,0) + 5°C
Winter ambient design temperature	-10,1	°C	ASHRAE 2025 extreme climate condition n=20
Supply critical chw temperature	23	°C	
Return critical chw temperature	33	°C	
Critical chw fluid type	Water	[-]	
Climate zone for ASHRAE 169	4A	[-]	
Chiller type	Screw	[-]	
Chiller vendor	Carrier	[-]	

Annualized mechanical Energy (MechE)

Equipment	Number	Static load [kW]	25% ITE [kWh]	50% ITE [kWh]	75% ITE [kWh]	100% ITE [kWh]	Remarks
Chillers	14	252	2300897	3436042	5357458	7631761	Working in N+2 at 261, 523, 784 and 1045 kw
Chiller pumps	14	20	1226400	1594320	1839600	2452800	
DM Fan walls	28	27	1471680	2207520	3433920	6622560	Working in N+2 at 116, 231, 347 and 463 kw
Electrical pods LV1 CRAHs	14	4	490560	490560	490560	490560	Assumed static
Electrical pods LV2 CRAHs	16	1,1	154176	154176	154176	154176	Assumed static
CER CRAHs	4	1	35040	35040	35040	35040	Assumed static
DOAS	2	40	700800	700800	700800	700800	Assumed static
Battery DX units	16	1,5	210240	210240	210240	210240	Assumed static
Electrical Gallery DX units	8	3	210240	210240	210240	210240	Assumed static
MMR DX units	4	3	105120	105120	105120	105120	Assumed static
Generator heaters	8	5	350400	350400	350400	350400	Assumed static
Pressurization units	3	1,5	39420	39420	39420	39420	Assumed static
Side stream filters	2	4	70080	70080	70080	70080	Assumed static
Total			7365053	9603958	12997054	19073197	
MechE [kWh]	**49039261**						

Annualized Mechanical Load Component (MLC)

Max MLC	**0,21**

Table 6.5 Maximum Annualized Mechanical Load Component (Annualized MLC)

	Design ITE Power > 300 kW				Design ITE Power ≤ 300 kW			
Climate Zone[a]	Process Heating Segment	Process Ventilation Segment	Process Cooling Segment	Maximum Annualized MLC	Process Heating Segment	Process Ventilation Segment	Process Cooling Segment	Maximum Annualized MLC
0A	0	0.01	0.28	0.29	0.01	0.01	0.35	0.37
0B	0	0.01	0.31	0.32	0.01	0.01	0.39	0.41
1A	0	0.01	0.29	0.30	0.01	0.01	0.35	0.37
1B	0	0.01	0.30	0.31	0.01	0.01	0.37	0.39
2A	0.01	0.01	0.26	0.27	0.01	0.01	0.33	0.35
3A	0.01	0	0.23	0.24	0.01	0.01	0.31	0.33
4A	0.01	0	0.20	0.21	0.02	0.01	0.30	0.33
5A	0.01	0	0.18	0.19	0.02	0.02	0.29	0.34
6A	0.01	0	0.18	0.19	0.02	0.02	0.27	0.31
2B	0.01	0	0.19	0.20	0.01	0.01	0.31	0.33
3B	0.01	0	0.19	0.20	0.01	0	0.30	0.33
4B	0.01	0	0.16	0.17	0.01	0.01	0.27	0.29
5B	0.01	0	0.16	0.17	0.02	0.02	0.26	0.30
6B	0.01	0	0.16	0.17	0.02	0.02	0.27	0.31
3C	0.01	0	0.16	0.17	0.01	0	0.26	0.27
4C	0.01	0	0.16	0.17	0.01	0	0.26	0.27
5C	0.01	0	0.16	0.17	0.01	0	0.26	0.29
7	0.01	0	0.16	0.17	0.03	0.03	0.26	0.31
8	0.01	0.01	0.14	0.15	0.03	0.04	0.25	0.32

a. Climate zones are as listed in ANSI/ASHRAE Standard 169.

Design MLC	**0,187**
Check	YES

MIL07

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STACK INFRASTRUCTURE

Report - Systems Description – Mechanical

MIL07-DBA-AZ-XX-RP-M-50001

07/11/2025

Status – S4/P01

Project Number: 13038001

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1. INTRODUCTION

This report describes the mechanical installations for the WS3 procurement phase of STACK MIL07 Data Center project. The DC has a total design IT power of 12 MW.

1.1. OFCI EQUIPMENTS

The critical mechanical equipments considered as free client deliveries are:

- Chillers
- DH Fan Wall units
- HVAC equipments of the electrical pods (CRAHs, DX units, fans, leak detection…etc)
- Fuel pump of the gensets and other mechanical equiments installed inside the genset container

The scope of works and service is indicated in the OFCI documents and in the SOR.

1.2. INSTALLATION PHASING STRATEGY

Critical systems and equipments will be installed in 2 phases, each phase is for 6 MW IT (1 DH for each phase). At full build-out the building will consist of 2 DH (6 MW each), for a total IT load of 12 MW.

The 2 critical phases are almost identical for mechanical installations, the only main difference is on the cooling generation where the redundancy is shared between the whole building, as described later.

The mechanical installations for the non-critical area (offices and storages), will be installed in phase 1.

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2. CODES AND STANDARDS

The engineering calculations are based on the latest Italian codes, the most relevant international standards for data center design and good engineering practices consistent with industry standards.

The main local laws are as follows:

- Legge dello Stato del 27 luglio 1934, n. 1265: *"Testo unico delle leggi sanitarie, e relative modifiche ed integrazioni."*
- D.P.R. del 19 marzo 1956, n. 302: *"Norme per prevenzione degli infortuni sul lavoro integrative di quelle generali emanate con D.P.R. 27 aprile 1955, n. 547."*
- D.P.R.del 19 marzo 1956, n. 303: *"Norme generali per l'igiene del lavoro."*
- Circolare del 18 dicembre 1958, n. 13643: *"Ministero dei lavori pubblici - Norme per la progettazione dei lavori relativi alle reti interne di distribuzione degli acquedotti e reti ed impianti di fognature."*
- Norma ISO n.2631 del 1974: *"Prescrizioni relative alle vibrazioni"*
- Disposizione del 4 febbraio 1977: *"Ministero dei lavori pubblici - Criteri, metodologie e norme tecniche generali di cui all'art. 2, lettera b), d), e), della legge 10-5-1976, n. 319, recante norme per la tutela delle acque dall'inquinamento."*
- D.P.R.del 24 maggio 1988, n. 236: *"Attuazione della direttiva CEE numero 80/778 concernente la qualità delle acque destinate al consumo umano, ai sensi dell'art. 15 della legge 16 aprile 1987, n. 183"*
- D.M. del 21 dicembre 1990, n. 443: *"Regolamento recante disposizioni tecniche concernenti apparecchiature per il trattamento domestico di acque potabile."*
- D.P.C.M. del 14 novembre 1997: *"Determinazione dei valori limite delle sorgenti sonore."*
- D.M. 10 marzo 1998: *"Criteri generali di sicurezza antincendio e per la gestione dell'emergenza nei luoghi di lavoro"*
- D.M. del 20 ottobre 1998: *"Requisiti tecnici per la costruzione, l'installazione e l'esercizio di serbatoi interrati."*
- D. Lgs. del 25 febbraio 2000, n. 93: *"Attuazione della direttiva 97/23/CE in materia di attrezzature a pressione."*
- D.P.R. del 6 giugno 2001, n. 380: *"Testo unico delle disposizioni legislative e regolamentari in materia edilizia."*
- D. L. del 8 luglio 2003, n. 235*: "Attuazione della direttiva 2001/45/CE relativa ai requisiti minimi di sicurezza e di salute per l'uso delle attrezzature di lavoro da parte dei lavoratori."*
- D.M. del 6 aprile 2004, n. 174: *"Ministero della Salute - Regolamento concernente i materiali e gli oggetti che possono essere utilizzati negli impianti fissi di captazione, trattamento, adduzione e distribuzione delle acque destinate al consumo umano."*
- Legge dello Stato del 03 agosto 2007, n. 123: *"Misure in tema di tutela della salute e della sicurezza sul lavoro e delega al Governo per il riassetto e la riforma della normativa in materia."*
- D.M. n. 37 22 gennaio 2008: *"Recante il riordino delle disposizioni in materia di attività di installazione degli impianti all'interno degli edifici"*
- D.Lgs. del 9 aprile 2008, n. 81: *"Testo Unico in materia di tutela della salute e della sicurezza nei luoghi di lavoro, e successive modifiche e integrazioni."*
- D.M. del 19 maggio 2010: *"Ministero dello Sviluppo Economico - Modifica degli allegati al decreto 22 gennaio 2008, n. 37, concernente il regolamento in materia di attività di installazione degli impianti all'interno degli edifici."*
- D. L. del 23 febbraio 2023, n. 18: *"Attuazione della direttiva (UE) 2020/2184 del Parlamento europeo e del Consiglio, del 16 dicembre 2020, concernente la qualità delle acque destinate al consumo umano"*

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The main codes applicable to the design are as follows:

- ANSI/NECA/BICSI-002: *"Data Center Design and Implementation Best Pratice"*
- Standard IEC: *"Appliances for air-conditioning for household and similar purpose"*
- ASHRAE: *"Thermal guidelines for Data Processing Environments"*
- ETSI TR 102 489: *"Thermal Management Guidance for equipment and its deployment"*
- DIN 1988-300: *"Codes of practice for drinking water installations"*
- UNI EN ISO 5136: *"Acustica - Determinazione della potenza sonora immessa in un condotto da ventilatori ed altri sistemi di movimentazione dell'aria - Metodo con sorgente inserita in un condotto"*
- ISO 9001: *"Sistemi di gestione per la qualità – Requisiti"*
- UNI 11169: *"Impianti di climatizzazione degli edifici - Impianti aeraulici ai fini di benessere - Procedure per il collaudo"*
- UNI EN 12056-2: *"Sistemi di scarico funzionanti a gravità all'interno degli edifici - Impianti per acque reflue, progettazione e calcolo"*
- UNI EN 12056-3: *"Sistemi di scarico funzionanti a gravità all'interno degli edifici – Sistemi per l'evacuazione delle acque meteoriche, progettazione e calcolo"*
- UNI EN 12097: *"Ventilazione degli edifici - Rete delle condotte - Requisiti relativi ai componenti atti a facilitare la manutenzione delle reti delle condotte"*
- UNI EN 12101-1: *"Sistemi per il controllo di fumo e calore - Parte 1: Specifiche per le barriere al fumo"*
- UNI EN 12101-2: *"Sistemi per il controllo di fumo e calore - Parte 2: Evacuatori naturali di fumo e calore"*
- UNI EN 12101-3: *"Sistemi per il controllo di fumo e calore - Parte 3: Specifiche per gli evacuatori forzati di fumo e calore"*
- UNI EN 12101-6: *"Sistemi per il controllo di fumo e calore - Parte 6: Specifiche per i sistemi a differenza di pressione – Kit"*
- UNI EN 12237: *"Ventilazione degli edifici - Reti delle condotte - Resistenza e tenuta delle condotte circolari di lamiera metallica"*
- UNI EN ISO 12241: *"Isolamento termico per gli impianti negli edifici e per le installazioni industriali - Metodi di calcolo"*
- UNI EN 13136: *"Impianti di refrigerazione e pompe di calore - Dispositivi di limitazione della pressione e relative tubazioni - Metodi di calcolo"*
- UNI EN ISO 14001: *"Environmental management systems -- Requirements with guidance for use"*
- UNI EN 16798-1: *"Prestazione energetica degli edifici - Ventilazione per gli edifici"*
- UNI EN 16798-17*: "Prestazione energetica degli edifici - Ventilazione per gli edifici - Parte 17: Linee guida per l'ispezione degli impianti di ventilazione e condizionamento dell'aria"*
- ISO 50001: "Sistemi di gestione dell'energia – Requisiti e linee per l'uso"

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3. MECHANICAL SYSTEMS

The critical mechanical installations consist of:

- Critical chilled water cooling system for DH and IT/EL rooms;
- DX critical cooling systems for IT/EL rooms;
- Critical ventilation systems for DH and IT/EL rooms;
- Fuel systems for generators;
- External pipework heat tracing system;
- Water leak detection system inside DH and IT/EL rooms;
- Fuel detection system;
- Glycol detection system for the chillers free cooling circuits;
- Mechanical smoke extraction systems.

The non-critical mechanical installations consist of:

- Non-critical VRF systems for office areas;
- Non-critical ventilation systems for office areas;
- Toilet exhaust ventilation systems.

3.1. EXECUTIVE SUMMARY

3.1.1. Cooling and Heating

The chilled water critical cooling system serves the Data Halls (DHs), the Meet Me Rooms (MMRs) and the Electrical Pods (EPs).

The system run with pure water, with 23/33 °C as supply and return temperatures.

The system generation is comprised of air cooled chillers per 12 MW of IT build out in an N+2 configuration. The chillers are phased in this way:

- Phase 1 (6 MW): 8 new chillers; 8 total chillers in N+2;
- Phase 2 (12 MW): 6 new chillers; 14 total chillers in N+2.

All chillers are located on rooftop platform for maintenance access. Each chiller is provided with an integral chilled water pump. Piping for the critical chilled water system is in a ring topology above the roof and is concurrently maintainable.

A Thermal Energy Storage system (TES) is provided at roof level, with tanks connected to the risers. Risers are in a N+1 configuration (2+1), the first 2 installed in phase 1. Each riser has 2 tanks connected in series.

Chilled water treatment and filtration is provided with air separators, side stream filtration, chemical dosing pots and pressurization units. Pressurization/degassing units are provided with redundancy.

DHs are air conditioned with Fan Walls. For each DH there are 14 units located in a perimeter mechanical gallery in an N+2 configuration.

EPs and CERs are conditioned via chilled water CRAHs located in the space with N+1 redundancy.

Essential systems such as Electrical Rooms Electrical Galleries and MMRs are conditioned with unitary split direct expansion (DX) systems in N+1 configuration.

Non-critical areas such as aDHin and office spaces are conditioned via VRF systems and electric heaters. The generation of VRF systems is with air-to-air heat pumps.

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3.1.2. Ventilation

Dedicated outside air-handling units (DOAS) provide outside air into data halls. Each DH is supplied by two redundant ventilation systems in N+1 configuration. 2 critical DOAS are installed on the roof in phase 1.

Electrical pods have their own ventilation systems:

- Ventilation provided by fans for LV rooms
- Continual extraction fans (N+1) for the battery rooms
- Ventilation for MV room to cool the transformer

Non-critical areas such as aDHin and office spaces are ventilated with dedicated DOAS located on the roof. Toilets air is extracted by dedicated fans.

3.1.3. Smoke extraction

Mechanical smoke extraction system is provided for the Data Halls according to fire local requirements.

Staircases and elevators are provided with smoke hatches at the top.

3.1.4. Fuel

Each generator has its own fuel tank installed underground below the road in front of the yard. The pump for the fuel supply system is located inside the generator container and all the equipments are part of the OFCI supplier scope.

The fuel tanks are refilled from a centralized cabinet, one for each phase. Local emergency refill points are deployed for each tank together with connections for a mobile fuel polisher unit.

3.1.5. Heat tracing and Leak Detection

Outdoor pipework (critical chw, fuel, potable water, wet fire suppression) are protected by frost with a trace heating system.

Leak detection systems present in the building are the following:

- Water leak detection inside the critical spaces to monitor eventual presence of water close to essential equipments
- Glycol detection on the roof for the chiller free-cooling loops
- Vacuum fuel detection for pipework and tanks

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3.2. CRITICAL COOLING

3.2.1. Design considerations

Outdoor Design Parameters

Outside temperature and humidity conditions – ASHRAE 2025 – Linate (MI) Weather Station

Summer:

- Dry bulb & wet bulb (n=20): 38.0°C DB & 28.5°C WB

For the summer condition a safety factor of 5 °C is taken into consideration to consider the air recirculation, so the Design Summer Temperature is: 38.0 + 5 = **43.0 °C**

Winter:

- Dry bulb (n=20): **-10.1°C** DB & -10.9°C WB

Indoor Design Parameters

The indoor Data Hall thermal environment is designed to meet the temperatures shown in the 2021 ASHRAE TC9.9 “Thermal Guidelines for Data Processing Environments.” The Class A1 range is:

Criteria	Recommended Range	Allowable Range	Design Range
Low end temperature	18°C	15°C	20°C
High end temperature	27°C	32°C	29,4°C (32°C fail)
Low end moisture	5.5°C dewpoint	20% RH	5.5°C dewpoint
High end moisture	70 % RH	80% RH	14.8°C dewpoint

The temperatures indicated shall be measured 2 m above the floor. It should be noted that the intent of this range is not to allow user selection of any condition within that range, but to allow the HVAC system to operate at its most efficient point to deliver conditions anywhere within the range.

The internal conditions of the other critical rooms are reported in the following table:

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Room Type	Summer		Winter	
	Indoor Temp.	Relative Humidity (%) Dew Point	Indoor Temp.	Relative Humidity (%) Dew Point
Electrical Pods LV	27 ± 1°C (max 35°C at UPS and STS inlet)	N/A	27 ± 1°C (max 35°C at UPS and STS inlet)	N/A
Comunication Equipments Rooms (CER)	27 ± 1°C	N/A	27 ± 1°C	N/A
Meet Me Rooms (MMR)	25 ± 1°C	N/A	25 ± 1°C	N/A
Electrical Galleries	25 ± 1°C	N/A	25 ± 1°C	N/A
Batteries	25 ± 1°C	N/A	25 ± 1°C	N/A
Electrical Pods MV	40 ± 1°C	N/A	40 ± 1°C	N/A

3.2.2. System description

Cooling on this site is primarily meant for cooling of the Data Halls, which are air cooled with Fan Wall units.

The Fan Wall units are connected to the chilled water system, with cooling generated with air cooled chillers.

Besides the chilled water connection for the data halls, connections on the critical cooling system are made for:

- CRAH units in the CER rooms and Electrical pods
- Storage tanks for TES system
- Heat recovery connections for future district heating installation

A TES system (Thermal Energy Storage) is installed on the roof to provide continuous cooling during a power fail. The system is designed to cover 5 minutes (300 sec). Chiller pumps are fed by UPS lines.

The cooling system consists of the following components:

- Air cooled chillers placed on the chiller gantry
- A distribution chilled water ring on roof level providing cooling for 12MW IT Load (6MW for each phase)
- Redundant chilled water distribution paths inside the building

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- Cooling units inside the rooms
- Storage tanks and motorized valves for TES system installed at roof level
- Pressurisation, expansion, degassing and filtration system in the roof level plant room (containerized solution)

The Electrical galleries, the MMR rooms and Batteries are cooled with DX units.

The MV pods are cooled with fans.

3.2.3. Chilled water distribution

The chilled water pumps inside the chillers, so part of the chiller supplier scope, distribute the cooling fluid (water) to a ring loop on the roof.

Critical risers are connected to the header and are in a N+1 configuration, 2 in phase 1 and 1 in phase 2.

Storage tanks are connected to the risers, so the TES system has an overall redundancy of N+1.

All cooling elements are connected to the chilled water distribution system and can be fed from 2 sides. Distribution is concurrently maintainable and internal pipes mainly run in the MEP galleries and in the corridors.

3.2.4. Chillers

Air-cooled chillers are installed on the roof platform. The chillers are equipped with a free cooling part and a glycol free kit (glycol present only in the free-cooling circuit). Chillers are client delivery equipments (OFCI scope). The number of chillers that will be installed for different IT Loads is: 8 for phase 1 6MW (N+2), 6 for phase 2 12MW (N+2). A total of 14 chillers will be installed in total.

Chillers	
Chiller capacity	1220 kW
Fluid	Water
Chilled water temperatures	23 / 33 °C
Redundancy	N+2 (12+2 for full build-out)
Total number of chillers on the final day	14 (8+6)

The chiller connection loop incorporates all necessary pump sets (OFCI scope), section valves, strainers etc. and all temperature and pressure sensors necessary to ensure reliable and consistent operation of the facility.

Pumps are variable volume, inverter driven and controlled by pressure difference.

The cooling system is set and maintained on a minimum pressure and is pressure controlled.

The minimum flow of the units is guaranteed by by-pass PICV valves installed at the bottom of each riser, inside the shafts.

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3.2.5. Data Hall cooling

The heat load within the Data Halls is cooled with air.

Air cooling is provided by Fan Walls installed on one side of the data halls: 14 units in total for each DH. The Fan Wall are a client delivery (OFCI scope).

DH Fan Walls	
Fan Wall cooling capacity (net)	540 kW
Air temperature	27 / 37,8 °C (Max ΔT 10,8°C)
Redundancy	N+2 (total 12+2 for each DH)
Total number of Fan Walls on the final day	28 (14+14)

The supply temperature is controlled by a motorized 2-way valve in the flow pipe of the chilled water system. The 2-way valve is part of the OFCI scope and internal to the Fan Wall unit.

The return air temperature into the Fan Wall is 37,8°C. The fan speed is controlled to maintain the return air temperature.

Fan walls are double feeded with ATS inside their panels.

In order to maintain resilience of operation, Fan Walls are connected to a cooling distribution ring concurrently maintainable.

3.2.6. CER and EP LV cooling

The CER rooms and Electrical pods LV are cooled with CRAH units connected in a ring structure to the main chilled water distribution system. The CRAHs are based on a down flow configuration with dropped fans.

CRAHs are double feeded with ATS installed inside their panels.

CRAHs for pods are OFCI scope.

EP critical powerblocks LV1 and 1R LV1 CRAHs	
CRAH cooling capacity (net)	105 kW
Air temperature	27 / 37 °C
Redundancy	N+1 (total 1+1 for each pod)
Total number of CRAHs on the final day	14 (8+6)

EP critical powerblocks LV2 CRAHs	
CRAH cooling capacity (net)	50 kW
Air temperature	27 / 37 °C
Redundancy	N+1 (total 1+1 for each pod)
Total number of CRAHs on the final day	12 (6+6)

EP 1R LV2 and 1H LV1 CRAHs	
CRAH cooling capacity (net)	25 kW
Air temperature	27 / 37 °C
Redundancy	N+1 (total 1+1 for each pod)
Total number of CRAHs on the final day	4 (4+0)

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CER CRAHs	
CRAH cooling capacity (net)	40 kW
Air temperature	27 / 37 °C
Redundancy	N+1 (total 1+1 for each CER)
Total number of CRAHs on the final day	4 (4+0)

The supply temperature is controlled by a motorized 2-way valve in the flow pipe of the chilled water system. The valve is supplied with the CRAH.

Reserve connections to the chw loop will allow the connection of additional CRAHs for an eventual future phase 2 catcher.

3.2.7. TES system

A Thermal Energy Storage system is installed to guarantee the critical continuous cooling during a power failure. The system is designed for 5 minutes (300 sec).

The water tanks are placed on the roof and connected to the critical risers. There are 3 group of tanks, 1 for each riser; risers are in a N+1 configuration. For each risers 2 tanks will be installed.

TES tank	
Tank capacity	35 mc
Tanks for each group (riser)	2 (70 mc for each group)
Tanks group redundancy	N+1 (2+1)
Total number of tanks on the final day	6 (4+2)

Chillers pumps and are fed from UPS lines.

Motorized valves for each group of tanks will allow the different working conditions of the system.

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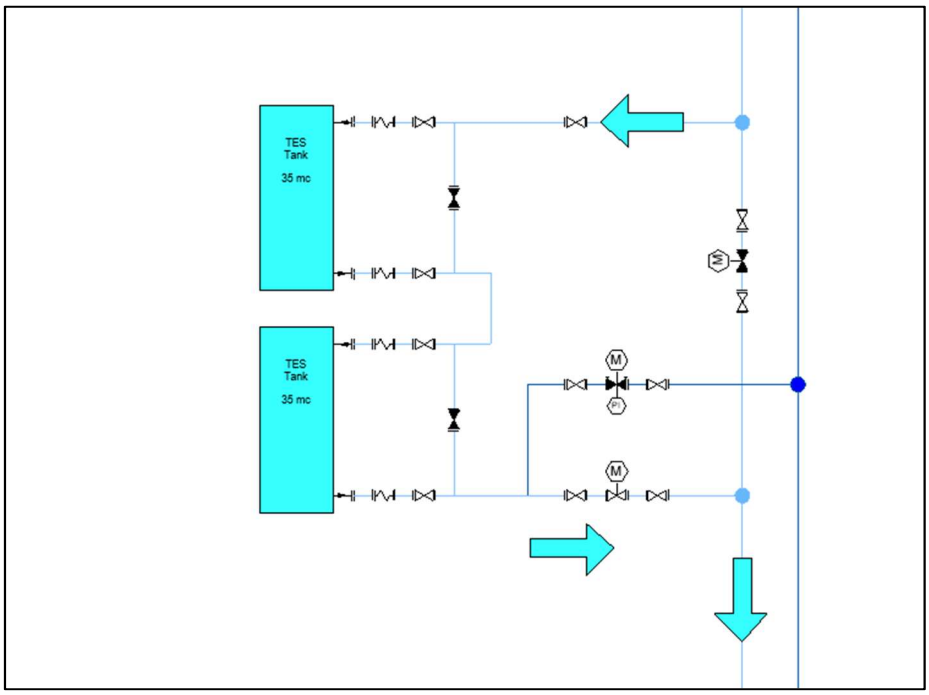
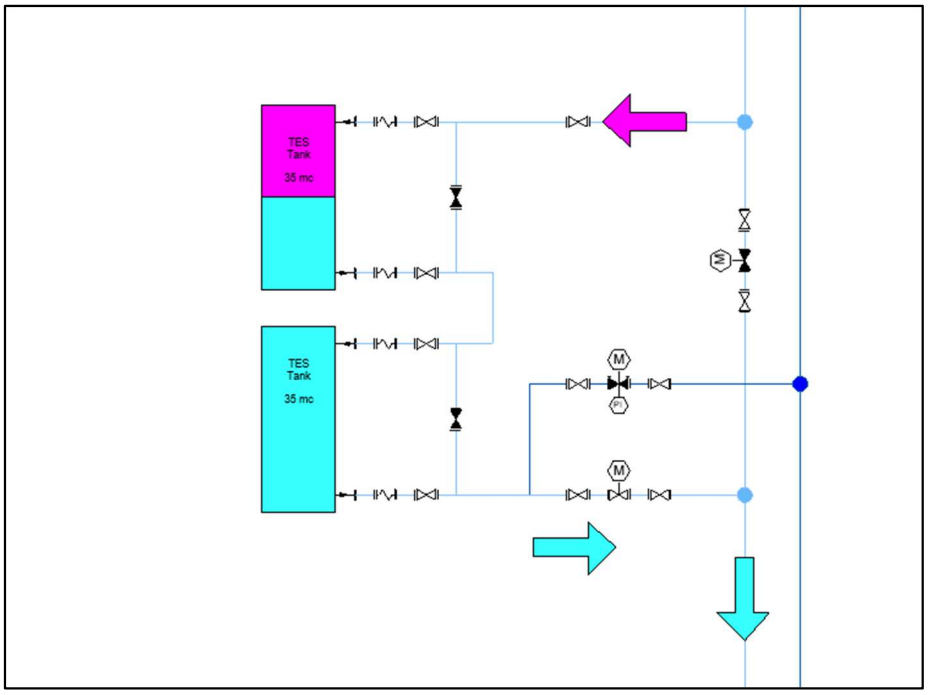
Normal working condition: water supply is passing through the tanks before reaching the consumers; water inside the tanks at 23 °C.



Failure working condition: chillers are off, water supply coming from the roof is at high temperature; tanks continue to supply low temperature water and start to empty.



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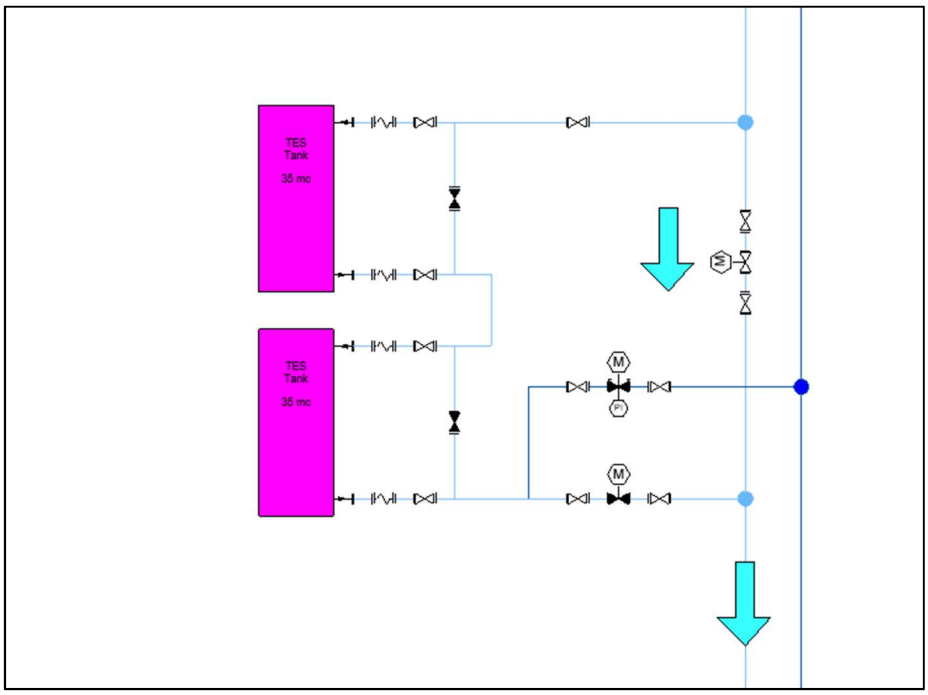
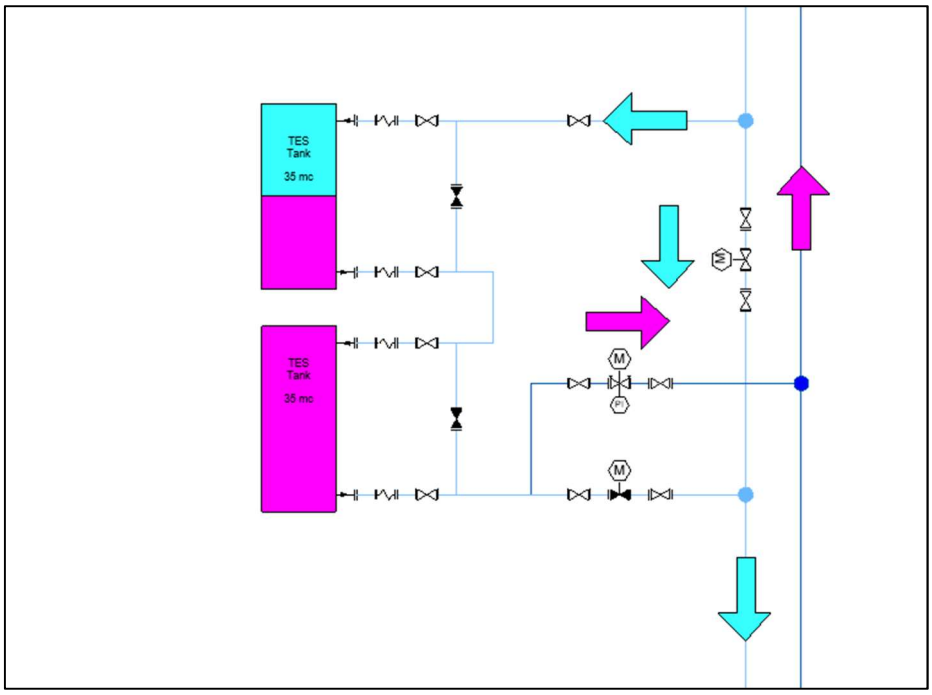
First phase after a failure: chillers start to work in a stable condition after the failure; tanks bypass is open while the tanks supply is closed, chillers supply cold water directly to the building.



Tanks refilling: chillers continue to supply consumers but their extra capacity (chillers working in N+2, or chillers working at lower ambient temperature) is used to refill the tanks; return motorized valve modulate controlled by system different pressure sensors.



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3.2.8. Electrical galleries, MMR and Battery cooling

The Electrical galleries are equipped with redundant single DX unit. The outdoor units are placed at the roof.

The DX systems maintain a room temperature of 25 ± 1°C.

Electrical gallery DX system	
DX system cooling capacity (net)	10 kW
Ambient air temperature range	10/30 °C
Redundancy	N+1 (total 3+1 for each gallery)
Total number of DX systems on the final day	8 (4+4)

The MMR are equipped with redundant single DX unit. The outdoor units are placed at the roof.

The DX systems maintain a room temperature of 25 ± 1°C.

IDF DX system	
DX system cooling capacity (net)	10 kW
Ambient air temperature range	20/25 °C
Redundancy	N+1 (total 1+1 for each room)
Total number of DX systems on the final day	4 (4+0)

The Battery are equipped with redundant single DX unit (OFCI scope). The outdoor units are placed on the side external walls of the pods.

The DX systems maintain a room temperature of 25 ± 1°C.

Battery DX system	
DX system cooling capacity (net)	10 kW
Ambient air temperature range	20/25 °C
Redundancy	N+1 (total 1+1 for each room)
Total number of DX systems on the final day	16 (10+6)

3.2.9. Pressurization, degassing and filtration system

Pressurization, degassing and filtration systems for the critical cooling water are installed inside container on the roof, one container for each phase.

The pressurization, degassing and refiling are managed by the same units that are provided in a N+1 redundancy. The units work with pump on separate circuits connected to the chiller ring on the roof.

Pressurization/Degassing system	
Vessel size	3 mc
Water temperature range	5/40 °C
Redundancy	N+1
Total number of systems on the final day	3 (2+1)

Side stream filters are provided for each phase connected with separate circuits to the chiller ring, without redundancy. The systems are made of a bag filter, pump, pressure sensors, control panel and a dosing pot for chemical additive. Everything installed on the same skid.

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3.2.10. Heat recovery system

Space reservation for a heat recover system to potentially connect the chilled water system to district heating is included in the design.

The current design does not detail this system except for the provision of stubs and valves on the critical return risers at roof level.

3.3. CRITICAL VENTILATION

3.3.1. Design considerations

In the following tables are reported the main design considerations for each critical space:

Ventilation design principles – Table 1			
Room	**Relative pressure**	**Recirculated air**	**Redundancy**
Data Hall	Positive	Yes	Yes, N+1 (for pressurization and humidity control)
Corridors	-	-	-
Electrical pods	Positive	Yes	No
CER rooms	Positive	Yes	No
MMR rooms	Positive	Yes	No
Batteries	Negative	No	Yes, N+1

Ventilation design principles – Table 2		
Room	**Air intake from**	**Air exhaust to**
Data Hall	Critical DOAS	Overflow to corridors
Corridors	Rooms overflows	Critical/Non-critical DOAS
Electrical pods	Independent ventilation system (OFCI scope)	Outdoor
CER rooms	Critical/Non-critical DOAS	Overflow to corridors
MMR rooms	Critical/Non-critical DOAS	Overflow to corridors
Batteries	Outdoor	Dedicated exhaust fans (OFCI scope)

The ventilation rates for critical spaces are reported in this table:

Ventilation design flow rates				
Room Type	**Occupancy (m2/person)**	**L/s per person**	**L/s*m2**	**Air Change per Hour**
Data Hall	0,04	2.5	0.3	-
Electical Pods	-	-	-	TBD by OFCI vendor
Battery	-	-	-	*
CER Rooms	-	-	-	0,5
MMR Rooms	-	-	-	0,5

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*Ventilation rates for batteries calculated according to CEI EN IEC 62485-2 or according to relevant code depending on the type and quantity of batteries installed. In case of lithium batteries an emergency extraction system is required to prevent hazard atmosphere, according to NFPA69 (5,1 l/s/m2). System TBD by OFCI vendor.

3.3.2. System description

Supply air in the Data Halls is provided by redundant Dedicated Outside Air System (DOAS) referred to as Data Center DOAS. The Data Center DOAS provide a positive pressure to the rooms and controls the humidity levels. The Data Center DOAS are part of the critical system.

Each data hall is kept on overpressure by supplying air on two sides of the room. Air is extracted from the corridor after transferring via an overflow damper.

All Data Center DOAS are placed on the roof.

The Data Hall DOAS units shall consist of the following sections:

- Supply air fan
- Supply air filter
- Heat recovery section
- Supply air direct expansion cooling/heating coil and equipment for heat rejection to ambient
- Supply air post-heat electric coil
- Supply air humidifier (resistive electric humidifier)
- Mixing section
- Exhaust air fan
- Exhaust air filter
- Other sections and equipment, such as dampers and empty sections where necessary

Humidification and dehumidification of supply air to the required condition is performed by the Data Center DOAS. A direct expansion cooling hall per DOAS control the maximum humidity level (dehumidification). Each DOAS has RTS humidifier to control the minimum humidity level (humidification).

The DH DOAS also supply air to CER and MMR. These spaces are positively pressurized with extraction from overflows into the corridor.

Electrical pods and batteries are ventilated by independent systems provided by the OFCI vendor, according to min desing requirements as specified above, technical codes and good practice. In particular batteries must be ventilated by a continuous extraction with 2 redundant fans.

MV pods have fans to control the temperature of the transformers. System to be defined by OFCI vendor according to equipments requirements and min design requirements.

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3.4. NON-CRITICAL HVAC SYSTEMS

3.4.1. Design considerations

Outdoor Design Parameters

Outside temperature and humidity conditions – ASHRAE 2025 – Linate (MI) Weather Station

Summer:

- Dry bulb & wet bulb: **33.8°C** DB & 26.0°C WB

Winter:

- Dry bulb (n=20): **-4.0°C** DB & -6.0°C WB

Indoor Design Parameters

The internal conditions of the non-critical rooms are reported in the following table:

Room Type	Summer		Winter	
	Indoor Temp.	Relative Humidity (%) Dew Point	Indoor Temp.	Relative Humidity (%) Dew Point
Offices, Break Rooms, Conference Rooms	26 ± 1°C	30-70%	20 ± 1°C	30-70%
Storage, Staging, Loading	26 ± 1°C	30-70%	20 ± 1°C	30-70%
Toilets	-	-	-	-
Corridor, Staircase	-	-	-	-
Technical Room	-	-	10 ± 1°C	-
Changing Room	-	-	20 ± 1°C	-

Ventilation Design Parameters

In the following tables are reported the main design considerations for each non-critical space:

Ventilation design principles – Table 1			
Room	Relative pressure	Recirculated air	Redundancy
Offices, Break Rooms, Conference Rooms	-	Yes	No
Storage, Staging, Loading	-	Yes	No
Toilets	Negative	No	No
Corridor, Staircase	-	-	-
Technical Room	Positive	Yes	No

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Ventilation design principles – Table 2		
Room	**Air intake from**	**Air exhaust to**
Offices, Break Rooms, Conference Rooms	Non-critical DOAS	Non-critical DOAS
Storage, Staging, Loading	Non-critical DOAS	Non-critical DOAS
Toilets	Non-critical DOAS	Separate exhaust fan
Corridor, Staircase	Rooms overflows	Critical/Non-critical DOAS
Technical Room	Non-critical DOAS	Overflow to corridors
Changing Room	Non-critical DOAS	Overflow to bathrooms

The ventilation rates for non-critical spaces are reported in this table:

Ventilation design flow rates				
Room Type	**Occupancy (m2/person)**	**L/s per person**	**L/s*m2**	**Air Change per Hour**
Office	0,05 (or number of seats)	2,5	0,3	-
Conference Room	0,5 (or number of seats)	2,5	0,3	-
Lobby	0,1	2,5	0,3	-
Break Room	0,5	2,5	0,6	-
Janitorial	-	-	5	-
Changing Room	-	-	2,5	-
Bathroom	-	-	12,5 (per each WC)	-
Storage	-	-	-	0,5
Staging, Loading	0,02	5	0,6	-
Corridor, Staircase	-	-	-	-
Technical Room	-	-	-	0,5

3.4.2. Systems description

The office and storage areas are conditioned via VRF systems with air to air heat pumps placed on the roof.

Interior terminals are fan coil or cassette style units. Each zone shall be thermally analyzed, and equipment sized to the respective load in the space.

Electrical radiators provide safety heating to technical rooms (10 °C) and heating for changing rooms (20 °C)

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All the office related rooms such as meeting rooms, entrance area, break room, storage room etc. are ventilated with the non-critical DOAS. The rooms have a balanced ventilation system with a supply and return air terminal.

Humidification and dehumidification of supply air to the required condition is performed by the DOAS. The DOAS has a RTS humidifier to control the minimum humidity level (humidification).

The non-critical DOAS are placed on the roof.

The non-critical DOAS unit shall consist of the following sections:

- Supply air fan
- Supply air filter
- Heat recovery section
- Internal heat pump system with cooling/heating coil and post heating heating coil on the supply line and cooling/heating coil on the return line in order to maximize the efficiency
- Supply air post-heat electric coil
- Supply air humidifier (resistive electric humidifier)
- Exhaust air fan
- Exhaust air filter
- Other sections and equipment, such as dampers and empty sections where necessary

Toilets fan installed in a doghouse on the roof manage the air extraction of this rooms.

Containers in the design (mechanical containers in the roof and fire room for the campus pump) are provided with independent ventilation system and DX systems to control the temperature (10/35 °C).

3.5. SMOKE EXTRACTION

According to the fire concept, mechanical smoke extraction ventilation is required for the Data Halls. Furthermore, natural smoke evacuation openings are required for each fire compartment.

These systems are intended to help the fire brigade in removing the smoke from the building after an emergency, making easier the access into the spaces. These systems are not intended as measure to save lives or goods.

Mechanical extraction systems airflows are determinate according to UNI 9494 appendix H.

Each system is made of a supply fan, a smoke extraction fan (fire rated F400) and smoke dampers installed directly on the dedicated system shafts. The systems will be all manually controlled by activation buttons located in the fire control room and automatic controlled by the fire alarm system, with an activation delayed by 10 minutes after the sprinkler discharge.

A smoke extraction system is also required in the staircases and elevator shafts consisting of a ventilation hatch at roof level and openable doors at the ground floor.

Roof hatches provide ventilation to staircases and elevators as required by code. The hatches are motorized and controlled by smoke sensors, timers and manual buttons in order to reduce the heat losses.

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3.6. FUEL SYSTEM

The emergency power system consists of 7 generators of 3.1 MW (4 in phase 1 and 3 in phase 2), and 1 house generator of 1,0 MW (phase 1). Each generator is served by a fuel tank installed under the container (belly tank), with an autonomy of 48h.

The fuel system consist of:

- Underground tanks (double walled)
- Belowground tanks filling lines (double walled pipes)
- Belowground dearation pipes for filling procedure (single walled pipes)
- Supply and return pipes from tank to generators (double walled pipes)
- Pumps from the fuel tanks, including valves and fittings; OFCI
- Connections for fuel polishing system for each fuel tank
- Vent pipes for each fuel tank
- Vacuum leak detection
- Centralized filling cabinet (one for each phase)
- Emergency local refill point for each fuel tank

Since a reserve spot is required to install in the future an eventual catcher system for phase 2, the underground installations for the fuel supply of this powerblock is required. The total amount of fuel systems to be installed is 9 (5 phase 1 and 4 phase 2)

3.7. FREEZING PROTECTION

Outdoor pipes will be insulated and protected by a trace heating system to avoid freezing risk in case of maintenance of a part of the pipework.

This system protects the following exposed pipes:

- Critical cooling pipes;
- Potable water pipes;
- Wet fire pipes;
- Fuel pipes.

The system is made of 5 different panels, divided by phases and locations:

- Phase 1 roof;
- Phase 2 roof;
- Phase 1 generator yard;
- Phase 2 generator yard;
- Campus fire pump

The trace heating panels will be supplied by two different feeds to guarantee redundancy, with ATS installed inside the panels.

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3.8. LEAK DETECTION

3 different detection systems are present in the building:

- Water leak detection inside the critical spaces to monitor eventual presence of water close to essential equipments
- Glycol detection on the roof for the chiller free-cooling loops
- Vacuum fuel detection for pipework and tanks

Water leak detection:

Areas inside critical rooms where there is water (fan walls, CRAHs, pipework in general) will be bounded at floor level if possible. In case where pipes are passing at high level drip tray will be installed below the pipes. Bunds and tray will be monitored by a leak detection system (cables).

Leak detection points will be installed also at the sides of the critical rooms doors to detect eventual water coming from the corridors.

One control panel will manage the system of the whole building, reporting alarm to the BMS system.

Glycol leak detection:

Glycol is present inside the chillers free-cooling loop. In order to monitor and block and eventual leakage of glycol a containment system is included into the design.

Below each chiller there is a tray that collect rainwater and eventual leakages from the units. The drains of all the trays of each phase are collected together to a monitoring point where a glycol sensor signal manages the opening or closing of a motorized valve. In case of glycol, the valve closes the system and all the leakage is contained inside the trays, and an alarm is sent to BMS. Without a glycol alarm, the valve is open and the water is delivered to the closest rainwater gutter.

Fuel leak detection:

A vacuum leak detection system is provided for the double walled pipes and tanks of the fuel system. There are two systems, one for each phase, with panels installed close to the centralized filling points.

3.9. MISCELLANEOUS

3.9.1. Seismic consideration

The building is located within seismic zone Class 3 with a maximum acceleration value of 0.73 m/s² at ground level per DECRETO 17/01/2018 (Strategic buildings class IV, ground category C-T1). All the equipment mountings shall be capable of withstanding additional dynamic loads that may be encountered as a result of this acceleration.

3.9.2. Sound criteria

An acoustic study still needs to be performed.

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3.9.3. Air quality criteria

Indoor Air Quality: To provide air filtration, outside air being brought into the building with the dedicated outdoor air system (DOAS) units is filtered with a minimum of ePM1 20% / M5 (pre-filter) and ePM1 70% / F7 (final filter) filters. Recirculating air handling units, including CRAHs and fan coil units (FCUs), are provided with ePM1 20% / M5 filtration.

Outdoor Air Quality: Locations of exhaust fans are at least 8 m away from any outside air intakes.

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MIL07

Via Lombardia 1, Siziano, MI, Italy

STACK INFRASTRUCTURE

Report - Statement of Requirements - Mechanical

MIL07-DBA-AZ-XX-RP-M-50002

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1. INTRODUCTION

This report describes the requirements of the mechanical installations for the WS3 procurement phase of STACK MIL07 Data Center project. The DC has a total design IT power of 12 MW.

The critical mechanical installations consist of:

- Critical chilled water cooling system for DM and IT/EL rooms;
- DX critical cooling systems for IT/EL rooms;
- Critical ventilation systems for DM and IT/EL rooms;
- Fuel systems for generators;
- External pipework heat tracing system;
- Water leak detection system inside DM and IT/EL rooms;
- Fuel detection system;
- Glycol detection system for the chillers free cooling circuits;
- Mechanical smoke extraction systems.

The non-critical mechanical installations consist of:

- Non-critical VRF systems for office areas;
- Non-critical ventilation systems for office areas;
- Toilet exhaust ventilation systems.

The contractor shall ensure completeness of all supplies, accessories and all essential works and services required for a proper completion of the works.

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2. SCOPE OF WORKS

2.1. SCOPE OF WORKS DEMARCATION

The contractor shall review the design and accept responsibility for proper construction and coordination of the cooling, heating and fuel systems in accordance with relevant standards, codes and design parameters listed hereinafter.

The scope of works to be supplied and installed shall include:

- Compliance with all codes and standards applicable to this jurisdiction
- Shop drawings for equipment
- Coordination documents
- Record drawings
- All component selections
- Systems and components in accordance with specifications and drawings
- Tags and labels
- Work associated with delivery, storage, and handling of products
- Work associated with provision of temporary facilities
- Design and provision of supports and anchors
- Pipe portals
- Equipment rails
- Access panels and doors
- Identification markers
- Coordination of electrical requirements for equipment provided
- Proper cleaning and closing
- Start-up service, commissioning, testing and training
- Certification
- CE marking and certificates
- O & M manuals / IOM manuals (Installation, Operation & Maintenance manuals)
- Preparation of posted operating instructions
- Meeting project safety and indemnity requirements
- Supplying proper warranty information
- Supply specified guarantee documentation

2.1.1. OFCI equipments

The critical mechanical equipments considered as free client deliveries are:

- Chillers
- DM Fan Wall units
- HVAC equipments of the electrical pods (CRAHs, DX units, fans, leak detection…etc)
- Fuel pump of the gensets and other mechanical equiments installed inside the genset container

The scope of works and service is indicated in the OFCI documents.

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2.1.2. Generator containers mechanical systems scope of works demarcations

	General Contractor	Generator Supplier
Cooling and ventilation systems inside the containers		X
Flues emission control systems		X
Chimneys and hot air hoods		X
Sprinkler pipework from the building dedicated control valves till the containers	X	
Sprinkler pipework and sprinkler heads inside the containers		X
Sewage underground pipework for containers and chimneys drains	X	
Commissioning	X	X
Controls of cooling and ventilation systems		X
Cabling between containers control panels and BMS system	X	

2.1.3. Fuel and urea system scope of works demarcations

	General Contractor	Generator Supplier
Generator control panels (GCP)		X
Fuel and urea pump sets		X
Fuel undergound tanks	X	
Fuel filling for commissioning and final filling	X	
Fuel pipes from underground tanks to genset containers	X	
Fuel systems inside the genset containers, included all required valves and equipments (day tanks)		X
Safety fuel supply closing system, including closing valve		X
Urea systems, urea tanks and urea filling for commissioning and final filling		X
Fuel systems from filling stations till fuel tanks	X	
Commissioning	X	X
Leak detection double walled piping and tank	X	
Leak detection inside the generator container		X
Controls fuel tank filling	X	
Controls fuel and urea pumps		X
Cabling between containers control panels and BMS system	X	
Mobile fuel polishing unit	X	

2.1.4. Electrical pods mechanical systems scope of works demarcations

	General Contractor	Electrical Pod Supplier
Cooling and ventilation systems inside the pods		X
Cooling pipse till the container to supply chw from the building system to the container CRAHs	X	
CRAHs interception and flushing valves installed outside of the containers	X	
CRAHs strainers and other required pipe accessories installed inside the container		X
Leak detection inside the containers		X
Sewage underground pipework for containers drains	X	
Sprinkler pipework from the building dedicated control valves till the containers	X	
Sprinkler pipework and sprinkler heads inside the containers		X
Commissioning mechanical systems	X	X
Controls of cooling and ventilation systems		X
Cabling between containers control panels and BMS system	X	

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2.2. INSTALLATION PHASING STRATEGY

Critical systems and equipments will be installed in 2 phases, each phase is for 6 MW IT (1 DM for each phase). At full build-out the building will consist of 2 DM (6 MW each), for a total IT load of 12 MW.

The 2 critical phases are almost identical for mechanical installations, the only main difference is on the cooling generation where the redundancy is shared between the whole building, as described later.

The mechanical installations for the non-critical area (offices and storages), will be installed in phase 1.

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3. CONTRACTORS' OBLIGATIONS

3.1. CONSTRUCTION DESIGN OBLIGATIONS

In preparation of and during the execution of the project the contractor shall fulfil the following term and conditions:

- Construct Work to conform to the project construction schedule
- Order the progress of mechanical work to conform to the progress of other trades
- Order the progress of mechanical work to conform to the progress of other trades
- Coordinate the work specified in this division with all other project work
- Prior to fabrication or installation participate in detailed coordination planning meetings with all other building utilities systems trades, so as to completely establish routings, elevations, space requirements, and coordination of layout and suspension requirements in relationship to the building structure and the work of all other trades
- The Contract documents, including specifications and construction drawings, are intended to provide all material and labour to install complete cooling and heating, systems for the building
- Contract drawings indicate general arrangement of mechanical systems. Information shown is generally schematic except where otherwise shown or detailed, and field verification of all dimensions, locations, and levels is required. In preparing its cost proposal, Contractor shall make allowances for adjustments needed to conform to conditions arising from field conditions and the work of other trades; architectural drawings shall govern the final installation requirements. Any discrepancies between drawings and/or specifications shall be brought to the attention of the Architect/Engineer in writing prior to opening of bids; subsequently, determination of responsibility for adjustments shall be at the sole discretion of the Architect/Engineer
- The Contractor shall refer to the architectural interior details, floor plans, elevations, and the structural and other Contract drawings and he shall coordinate his work with that of the other trades to avoid interference. The plans are diagrammatic and show generally the locations of the fixtures, equipment, and pipelines and are not to be scaled; all dimensions and existing conditions shall be checked at the building
- Where exposed work or connections to Owner's fixtures or equipment is shown in schematic form, the Contractor shall review the proposed configuration of such work or connections with the Owner's authorised representative before proceeding and shall comply with the Owner's requirements
- Drawings and specifications are complementary to each other. Include any work, materials or equipment indicated on the drawings but not described by the specifications or described by the specifications but not shown on the drawings, which is necessary for the completion of mechanical systems
- Although such work may not be specifically indicated, furnish and install all supplementary or miscellaneous items, appurtenances and devices incidental to or necessary for a complete mechanical system
- Prepare drawings showing proposed rearrangement of work to meet job conditions, including changes to work specified under other sections. Obtain permission of Architect/Engineer before proceeding
- The Contractor shall comply with the project closeout requirements

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3.2. GENERAL OBLIGATIONS

In general, the following preconditions are applicable for the project:

- Examine all existing conditions at building site
- Review contract documents and technical specifications for extent of new work to be provided
- Provide and pay for all permits, licenses, fees and inspections
- Prepare a Construction IAQ Management Plan
- Install equipment and materials to provide required access for servicing and maintenance. Coordinate the final location of concealed equipment and devices requiring access with final location of required access panels and doors. Allow ample space for removal of all parts that require replacement or servicing. This work shall include furnishing and installing all access doors required for mechanical access
- Verify final locations for rough ins with field measurements and with the requirements of the actual equipment to be connected. Refer to Equipment Specifications for rough-in requirements
- Coordinate mechanical equipment and materials installation with other building components
- Verify all dimensions by field measurements
- Arrange for chases, slots, and openings in other building components to allow for mechanical installations
- Coordinate the installation of required supporting devices and sleeves to be set in poured-in-place concrete and other structural components, as they are constructed
- Sequence, coordinate, and integrate installations of mechanical materials and equipment for efficient flow of the work. Give attention to large equipment requiring positioning prior to closing-in the building
- Coordinate the cutting and patching of building components to accommodate the installation of mechanical equipment and materials. Contractor to provide for all cutting and patching required for installation of his work unless otherwise noted
- Where mounting heights are not detailed or dimensioned, install mechanical services and overhead equipment to provide the maximum headroom possible
- Install mechanical equipment to facilitate maintenance and repair or replacement of equipment components. Connect equipment for ease of disconnecting, without interference with other installations
- Coordinate the installation of mechanical materials and equipment above ceilings with ductwork, piping, conduits, suspension system, light fixtures, cable trays, sprinkler piping and heads, and other installations
- Coordinate connection of mechanical systems with exterior underground and overhead utilities and services. Comply with requirements of governing regulations, franchised service companies, and controlling agencies. Provide required connection for each service
- All materials (such as insulation, ductwork, piping, wiring, controls, etc.) located within air plenum spaces, air shafts, and occupied spaces shall have a flame-spread index of 25 or less, and smoke-developed index of 50 or less in addition, the products, when tested, shall not drip flame particles, and flame shall not be progressive. Provide Underwriters Laboratories, Inc., label or listing, or satisfactory certified test report from an approved testing laboratory to prove the fire hazard ratings for materials proposed for use do not exceed those specified
- Coordinate installation of floor drains and floor sinks with work of other trades, such that finished floor slopes to drains and floor sinks are flush with surrounding floor
- Products made of or containing lead, asbestos, mercury or other known toxic or hazardous materials are not acceptable for installation under this division. Any such products installed as part of the work of the division shall be removed and replaced and all costs for removal and replacement shall be borne solely by the installing Contractor

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3.3. MINOR DEVIATIONS

The drawings are diagrammatic and show the general arrangements of all mechanical work and requirements to be performed. It is not intended to show or indicate all offsets, fittings, and accessories which will be required as a part of the work of this section.

The Contractor shall review the structural and architectural conditions affecting his work. It is the specific intention of this section that the contractor's scope of work shall include:

- Proper code complying support systems for all equipment whether or not scheduled or detailed on drawings or in these specifications
- Minor deviations from the mechanical plans required by architectural and structural coordination

The Contractor shall study the operational requirements of each system, and shall arrange his work accordingly, and shall furnish such fittings, offsets, supports, accessories, as are required for the proper and efficient installation of all systems from the physical space available for use by this section. This requirement extends to the Contractor's coordination of this section's work with the “Electrical Work”. Should conflicts occur due to lack of coordination, the time delay, cost of rectification, demolition, labour and materials, shall be borne by the Contractor and shall not be at a cost to the Owner.

Minor deviations in order to avoid conflict shall be permitted where the design intent is not altered.

Advise the Engineer, in writing, in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Engineer of conflict.

3.4. PRODUCT SUBSTITUTIONS

When proposing alternative products:

- The Contractor shall certify the following items are correct when using substituted products other than those scheduled or shown on the drawings as a basis of design
- Substituted product to be approved by the owner/engineer
- The Contractor shall pay for changes to building design, including engineering design, detailing, structural supports, and construction costs caused by proposed substitution
- The proposed substitution has no adverse effect on other trades, construction schedule, or specified warranty requirements
- Maintenance and service parts available locally are readily obtainable for the proposed substitute
- The Contractor further certifies function, appearance, and quality of proposed substitution are equivalent or superior to specified item
- The Contractor agrees that the terms and conditions for the substituted product that are found in the contract documents apply to this proposed substitution

3.5. CODES AND REQUIREMENTS

Unless otherwise stated in these general and special conditions and in the work description, the following shall apply to quotations, assignment of work and execution:

- The Contractor shall ensure that the completed works fully comply with all applicable Italian / local Norms, Standards, Codes, Regulations and Statutory Regulations
- In addition, the Contractor shall fully comply with the requirements of all design / manufacture / installation and testing standards identified in the tender documents. Where no standard is

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given, the Contractor shall adopt the appropriate UNI standard or international (ISO, IEC etc.) or European (EN) standard as the default standard. Other specific Standard requirements are: ASHRAE Guidelines; CIBSE Guides; BESA Guides; applicable By-laws and other Regulations and local authority agreements or requirements
- Quality of work shall be in accordance with local standards and regulations
- The Contractor shall ensure that the design, materials and installation do not conflict with any instructions from the authorities. Failure to meet this requirement will be the Contractors responsibility to rectify at his cost
- Local conditions, Standards and Regulations only supersede this Specification where they demand a higher standard
- The Contractor shall ensure that all manufacturers used and all plant, equipment and ancillaries utilised for this project have been fully inspected, approved and certified by the local authority that has jurisdiction. Under no circumstances shall any items not so certified be used
- Design and fabrication of equipment, and all operations connected therewith, are subject to the approval, inspection, by-laws, and regulations of all local authorities and all organisations and other public services having jurisdiction
- The Contractor shall submit all drawings and other documents as necessary to apply for, and obtain, all such approvals
- All necessary applications for fabrication (and cost thereof) for approval shall be included in the Works. Any changes or alterations required by the authorised inspector of the authority having jurisdiction shall be made without charge
- The Contractor shall supply and install all warning signs and nameplates as required by the local building and labour inspection authorities
- The properties of equipment and the design, performance, characteristics, and methods of construction of all items shall be in accordance with the latest edition of applicable Codes

3.5.1. Standards, guidelines, specifications or regulations

In cases where two codes or standards conflict, the most stringent criteria shall govern, unless agreed otherwise by the Client.

Compliance with any requirements issued by regulatory bodies shall not decrease the quality of workmanship and material specified herein.

3.5.2. Seismic considerations

The building is located within seismic zone Class 3 with a maximum acceleration value of 0.73 m/s² at ground level per DECRETO 17/01/2018 (Strategic buildings class IV, ground category C-T1). All the equipment mountings shall be capable of withstanding additional dynamic loads that may be encountered as a result of this acceleration.

3.6. SHOP DRAWINGS AND EQUIPMENT SUBMITTALS

Prior to construction the contractor shall submit for review details of all materials and equipment.

After approval of preliminary list of materials, the Contractor shall submit Shop Drawings (including native files) and manufacturer's Certified Drawings to the Client Representative for approval.

The Contractor shall submit approved Shop Drawings and manufacturer's equipment cuts, of all equipment requiring power and controls connection, to the Electrical Contractor for final coordination of electrical requirements. Contractor shall bear all additional costs for failure to coordinate.

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Submittals and Shop Drawings shall be submitted in PDF format as a complete bound package. The approved submittals shall be converted into Operations & Maintenance Manuals at the completion of the project. Submit typed copies of submittals (number to be determined during construction).

RFIs and submittals are to be sent to via a digital document management platform of the Client preference:

- Include the project title and Submittal number in the e-mail subject line
- Provide copy of Record Drawings to Testing and Balancing Contractor for their use when doing their work

3.6.1. Request for information and submittals

Requests for Information:

- All RFIs are required to be in electronic format using a digital construction management system
- RFIs that are larger than 10MB should be reviewed for other possible means for electronic transfer – sharefile, SharePoint, FTP, etc
- Include the project title and RFI number in the e-mail subject line

Submittals:

- All submittals are required to be in electronic format using a digital construction management system
- Submittals that are larger than 10MB should be reviewed for other possible means for electronic transfer – sharefile, SharePoint, FTP, etc
- Include the project title and Submittal number in the e-mail subject line

3.6.2. Unit pricing submittals

Prior to construction submit for review all materials and equipment in accordance with this division of the specification.

Preliminary List of Materials and Unit Price Items: Within thirty (30) days after awarding of the Contract, submit to Owner for preliminary approval a complete list of manufacturer's names and model numbers of proposed materials and equipment. Also include proposed list of unit price items for review:

- Indicate substituted items
- Identify test and balancing agency

The Contractor shall submit with preliminary list of materials a unit price list for each item furnished on this project. Included with price shall be labour cost index.

Submittals and Shop Drawings shall be submitted in PDF format as a complete bound package. Submit six (6) typed copies of submittals.

3.6.3. Coordination documents

The Contractors shall prepare coordinated Shop Drawings to coordinate the installation and location of all HVAC equipment, ductwork, grilles, diffusers, piping, fire sprinklers, lights, audio/video systems, electrical services and all system appurtenances. The Drawings shall include all mechanical rooms and floor plans. The Drawings shall be Overlay Drawings showing each discipline

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on a single sheet. The Drawings shall be keyed to the structural column identification system and shall be progressively numbered. Prior to completion of the Drawings, the Contractor shall coordinate the proposed installation with the Architect and the structural requirements, and all other trades (including HVAC, Plumbing, Fire Protection, Electrical, Ceiling Suspension, and Tile Systems), and provide reasonable maintenance access requirements. When conflicts are identified, modify system layout as necessary to resolve. Do not fabricate, order or install any equipment or materials until coordination documents are approved by the General Contractor, Architect, and Owner. Within thirty (30) days after award of Contract, submit proposed coordination document Shop Drawing schedule, allowing adequate time for review and approval by parties mentioned above. Drawings should be prepared and submitted for approval on a floor-by-floor basis to phase with building construction.

The Drawings shall be prepared as follows:

- The Mechanical Contractor shall prepare Drawings to an accurate scale of 1:50 or larger, Drawings shall indicate location, size and elevation above finished floor, of all HVAC equipment, ductwork, and piping. Plans shall also indicate proposed ceiling grid and lighting layout, as shown on electrical plans and reflected ceiling plans
- The Plumbing Contractor shall obtain reproducible plans from the Mechanical Contractor, and indicate all plumbing lines including fittings, hangers, access panels, valves, and bottom of pipe elevations above finished floor
- The Fire Protection Contractor shall obtain reproducible plans with the detailed mechanical and plumbing work shown. The Sprinkler Contractor shall indicate location of all sprinkler heads and piping, including valves and fittings, dimensions from column lines, and bottom of pipe elevations above finished floor
- Plans are to incorporate all addenda items and change orders
- Distribute plans to all trades and provide additional coordination as needed

Advise the Engineer and Owner in the event a conflict occurs in the location or connection of equipment. Bear all costs for relocation of equipment, resulting from failure to properly coordinate the installation or failure to advise the Engineer and Owner of conflict.

Provide means of access to all valves, dampers, controllers, operable devices, and other apparatus that may require adjustment or servicing.

Verify in field exact size, location, invert, and clearances regarding all existing material, equipment and apparatus, and advise the Engineer and Owner of any discrepancies between those indicated on the Drawings and those existing in the field prior to any installation related thereto.

Final Coordination Drawings with all appropriate information added are to be submitted as Record Drawings at completion of project.

3.6.4. Drawings

Drawings indicate equipment capacities, tagging and labelling, sizes, locations, connections to equipment and methods of installation.

Before proceeding with work check and verify all dimensions.

Assume all responsibility for fitting of materials and equipment to other parts of equipment and structure.

Make adjustments that may be necessary or requested, in order to resolve space problems, preserve headroom, and avoid architectural openings, structural members and work of other trades.

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If any part of Specifications or Drawings appears unclear or contradictory, apply to Architect or Engineer for his interpretation and decision as early as possible, including during bidding period.

3.6.5. Shop drawings

Piping System:

Draw to a scale not less than 1:20, with sheet sizes equal to Contract Drawings.

Indicate layout of each piping system. Indicate piping system routing showing pipe sizes, elevations, critical dimensions, valve locations, and manhole locations. Indicate on shop drawings leak detection and locating system routing and panel location.

Indicate gradients of pipework, air vents and drain valves, show expansion provisions, including guides and anchors.

The contractor shall include on his shop drawings full details of all support systems and shall submit these to the Clients representative for approval. Anti-vibration supports shall be fitted at all locations where pipework vibration is likely to be a problem.

Ductworks and plenums:

Draw to a scale not less than 1:20, with sheet sizes equal to Contract Drawings.

Show duct sizes, where possible use even duct sizes.

Show fitting details and access hatches

Show coordination with lighting fixtures, fire dampers, smoke dampers, piping, diffusers, grilles, registers, fans, major electrical runs, cable trays and bus ducts.

Field erected mechanical equipment:

Draw to a scale of 1:20, with sheet sizes equal to Contract Drawings.

Show plan, sections, elevations and details of all joints and enclosures.

Detail access doors and hardware.

Detail coil, damper, humidifier, filter and fan installations.

Show access space for electrical components that are part of the equipment provided and/or installed such as power and control panels on humidifiers.

Air Handling Units:

Provide to a scale of 1:20 shop drawings for each air handling unit drawn to scale and showing each component of the unit. Include plan, elevation, and end view of air handling units.

3.6.6. Product data

Submit for each component Product Data including:

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- Manufacturer's technical product data
- Indicating data figures such as dimensions, flow, capacity, pressure setting, tolerances etc

Submit for each component Maintenance Data including:

- Maintenance instructions, including instructions for lubrication, valve replacement
- Spare parts lists
- Include this data, product data, and shop drawings in operating and maintenance manuals.

Piping:

- Submit data on pipe materials, fittings, and accessories. Submit manufacturers catalogue information
- Valves: Submit manufacturer's catalogue information with valve data and ratings for each service
- Hangers and Supports: Submit manufacturer's catalogue information including load capacity
- Piping Specialties: Submit manufacturer's catalogue information including capacity, rough-in requirements, and service sizes
- Leak Detection and Location System: Submit manufacturer's catalogue information for controller, alarm unit, cable type, and pipe containment
- Design Data: Indicate pipe size. Indicate load carrying capacity of trapeze, multiple pipes, and riser support hangers

Pumps:

- Submit certified pump curves showing performance characteristics with pump and system operating point plotted. Include NPSH curve when applicable. Include electrical characteristics and connection requirements. Submit also, manufacturer model number, dimensions, service sizes, and finishes
- Pumps: Manufacturer's Installation Instructions: Submit data for each type of pump
- Submit manufacturer's shop drawings indicating dimensions, weight (shipping, operating), required clearances, methods of assembly of components, and location and size of each field connection
- Manufacturer's Certificate: Certify Products meet or exceed specified requirements, especially to be rated for outdoor conditions down to -17.4°C (N=20)
- Manufacturer's Field Reports: Submit report of each visit of manufacturer's representative to provide technical assistance during installation
- Maintenance Data: Submit maintenance instructions, including instructions for lubrication, tube replacement, motor and drive replacement, and spare parts lists. Include this data, product data, shop drawings, and wiring diagrams in operating and maintenance manuals
- Wiring Diagrams: Submit manufacturer's ladder-type wiring diagrams for power and control wiring required. Differentiate between factory-installed and field-installed wiring

Ventilation, submit for approval on all materials and equipment, including:

- Ductwork – rigid and flexible
- Ductwork specialties
- Flexible connections
- Sealants, adhesives and tapes
- Duct access panels and doors
- Backdraft dampers
- Control dampers
- Fire and fire-smoke dampers
- Diffusers, grilles, and registers
- Variable Air Volume (VAV) boxes
- Fan powered air terminal

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Air Handling Units:

- Submit product data for all materials and equipment in the AHU to demonstrate compliance with every requirement of the schedules and specifications. When product data is insufficient to demonstrate compliance, provide information type written on the manufacturer's letterhead. Provide separate fully approved 'Issued For' Construction product submittal data prior to commencing production of units unless receiving owner's authorization to proceed in writing prior to final approval of full product submittal data package.
- Product Data Submittal shall include:
    - Product data for all components and subsystems.
    - Provide total system pressure drop within the air handling unit based on the scheduled external static pressures and all internal pressure losses including: coils, dampers, louvers, filters, humidifiers, sound attenuators, systems effects, etc. The manufacturer shall submit total pressure drop calculations which shall be done at the full design flow of the air handling unit or component. Where provided include mixing box static pressure losses in internal static pressure.
    - Filter pressure drop allowance. The air handling unit manufacturer shall base filter pressure drops for fan sizing on the manufacturer's recommended change-out pressure drop. The manufacturer shall submit the filter data supporting their calculations.
    - Unit controls internal sequence and P&I D diagram
    - Control points list
    - Control system programming
    - Factory-certified performance ratings on the following:
    - Direct Evaporative media
    - Fan performance with curves showing specific scheduled operating point.
    - Full unit electrical diagram, including all connections, fuses, and powered components. Shall include separate diagrams for primary and control power systems.
    - Control system
    - Manufacturer's Installation instructions

3.6.7. Test reports

Submit written test results for piping system pressure test.

Manufacturer's Installation Instructions: Submit piping system, piping accessories and leak detection and location system data.

Manufacturer's Certificate:

- Certify Products meet or exceed specified requirements
- Submit certificate of evaluation of leak detection and location system by independent third party
- Manufacturer's Field Reports: Submit report of each visit of manufacturer's representative to provide technical assistance during installation
- Welders Certificates: Certify welders employed on the Work, verifying qualification within previous 12 months

3.6.8. Testing, Adjusting and balancing

Forms:

- The Contractor shall deliver a complete copy of standard forms for testing and balancing work associated with the project
- These forms shall serve as specific guidelines for producing final test report
- Hybrid or non-standards forms are not acceptable

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- Data shall include, but not be limited to, a title page with building information, instrument lists, air flows, water flows, temperatures, sound levels, capacities, nameplate data

Test Reports:

- Provide six (6) certified test reports, signed by the test and balance supervisor who performed the work
- The final reports shall include identification and types of instruments used, and their most recent calibration date, and key plans identifying all inlets and outlets
- Final test reports shall be typed
- Handwritten reports are not acceptable

Maintenance Data:

- Include, in maintenance manuals, copies of certified test reports and identification of instruments

Qualifications:

- The Contractor shall submit the certified individual qualifications of all persons responsible for supervising and performing the actual work and the name of the certifying engineer
- Provide a reference list of five (5) similar size projects with contact person and telephone number

3.6.9. Closeout submittals

Up to date As-Built Revit model at RIBA 6.

Project Record Documents: Record actual locations of valves, piping system, and system components.

Project Record Documents: Record actual locations of piping mains with invert elevations, valves, manholes, and leak detection and location system.

Identify and describe unexpected variations to subsoil conditions or discovery of uncharted utilities.

3.7. EXECUTION

3.7.1. Qualifications

Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Leak Detection Systems: Company specializing in manufacturing products specified in this section with minimum three years documented experience.

Installer: Company specializing in performing Work of this section with minimum three years documented experience approved by manufacturer.

3.7.2. Delivery, storage, and handling

General:

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- Deliver products to project properly identified with names, model numbers, types, grades, compliance labels, and similar information needed for distinct identifications; adequately packaged and protected to prevent damage during shipment, storage, and handling
- Store equipment and materials in an environmentally controlled area at the site, unless off-site storage is authorized in writing. Protect stored equipment and materials from damage. Piping shall be stored in bundles covered with waterproof membrane. Piping showing signs of rust shall be removed from site and replaced
- Coordinate deliveries of mechanical materials and equipment to minimize construction site congestion. Limit each shipment of materials and equipment to the items and quantities needed for the smooth and efficient flow of installations
- Comply with the manufacturer's rigging and installation instructions

Products:

- Accept valves on site in shipping containers with labelling in place. Inspect for damage
- Protect piping and fittings from soil and debris with temporary end caps and closures. Maintain in place until installation
- Accept pumps on site in shipping containers with labelling in place. Inspect for damage
- Accept OFCI equipment on site. Inspect for damage. Equipment to be transported and installed by the contractor per the supplier’s instructions.

3.7.3. Safety and indemnity

No act, service, Drawing, review, or Construction Review by the Owner, Architect, Engineers or their consultants, is intended to include the review of the adequacy of the Contractor's safety measures, in, on, or near the construction site.

3.7.4. Observation of the works

The Contractor shall provide opportunity for the Architect/Engineer, Code Enforcement Authorities and/or the Owner's representative to examine all work prior to concealment. This includes exterior piping and services prior to backfill of trenching, all interior roughing-in of piping, ductwork or equipment prior to insulating or other concealment. The Contractor shall notify the Architect/Engineer and/or the Owner's representative at least 72 hours in advance of such work so that the appropriate representative(s) may perform such observations prior to concealment. Notification of Code Enforcement authorities sufficiently in advance of concealing work is the Contractor's responsibility.

3.7.5. Temporary facilities

Provide temporary heating, air conditioning, ventilation, water, and sewer, etc. services as necessary during the construction period.

Temporary Heating for Commissioning Tests:

- Provide temporary heating where needed to provide false load for commissioning tests
- Temporary heating may be from the permanent heating system of the project or from a dedicated temporary heating system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon what work in place or being installed

Temporary Cooling for Commissioning Tests:

- Provide temporary cooling where needed to provide false load for commissioning tests

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- Temporary cooling may be from the permanent cooling system of the project or from a dedicated temporary cooling system. If temporary system is necessary, select facilities known to be safe and without deleterious effect upon the work in place or being installed

3.7.6. Environmental requirements

Materials / components and systems to be installed as per the supplier requirements.

3.7.7. Field measurements

Verify field measurements prior to fabrication.

3.8. FINAL OBSERVATION

At completion of the work, the Contractor shall notify the Architect/Engineer and request the final observation.

Prior to such request, all work under the contract shall be completed and all systems shall be in proper working order and placed in operation.

All air and water systems shall be properly balanced with quantities shown on the drawings, and all water circuits shall be adjusted to provide the proper flows.

All equipment shall be cleaned, including plumbing fixtures. All debris and construction materials shall be removed from the premises.

Control and instrumentation systems shall be complete and in proper working order. All instruments shall be properly and accurately field calibrated.

At the request of the Architect/Engineer, a representative of the Contractor who is thoroughly familiar with the project and operation of the various systems shall be present during the final observation to demonstrate proper operation of the equipment and controls. If requested, the contractor shall have representatives from his subcontractors present to assist during final observation.

3.9. RECORD DRAWINGS

Before commencing installation, obtain an extra set of prints from the Engineer, marked “Record”. This set of drawings shall be kept at the construction site at all times and used for no other purpose but to mark on it all the changes and revisions to the Contract Drawings resulting from coordination with other trades. At the completion of the project:

- Edit project Revit files to incorporate all site mark-ups, changes, and revisions to the Contract Drawings. This shall be done as documented in the BIM requirements
- Provide copy of Record Drawings to Testing and Balancing Contractor for use when doing his work.
- Mark Drawings to indicate revisions to piping and ductwork, size and location both exterior and interior; including locations of coils, dampers and other control devices, filters, boxes and similar units requiring periodic maintenance or repair; actual equipment locations, dimensioned from column lines; actual inverts and locations of underground piping; concealed equipment, dimensioned to column lines; mains and branches of piping systems, with valves and control devices located and numbered, concealed unions located, and with items requiring maintenance located (i.e. – valves, traps, strainers, expansion compensators, tanks, etc.); Change Orders; concealed control system devices

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- Mark Specifications to indicate approved substitutions; Change Orders; actual equipment and materials used

3.10. START-UP SERVICE AND BUILDING COMMISSIONING

Prior to start-up, be assured that systems are ready, including checking the following: Proper equipment rotation, proper wiring, auxiliary connections, lubrication, venting, controls, and installed and properly set relief and safety valves.

Provide services of factory-trained technicians for start-up of air conditioning units, temperature controls, chillers, pumps and other major pieces of equipment. Certify in writing compliance with this Paragraph, stating names of personnel involved and the date work was performed.

Contractor shall be responsible for assisting Owner and 3rd party commissioning agent during testing and shall be responsible for resolving issues with equipment and workmanship discovered therein.

The Owner will contract separately for the services of an independent commissioning agent. The independent commissioning agent will perform testing of completed systems, including the following:

- Pre-functional tests
- Equipment level functional tests
- System level functional tests
- A final integrated system test

The Contractor shall cooperate with the independent commissioning agent, and coordinate construction activities with the independent commissioning agent. In addition, the contractor shall promptly correct any deficiencies noted by the independent commissioning agent.

The independent commissioning agent will conduct an integrated system test at the completion of construction activities. This test is being conducted to assure proper performance of all building systems when operated together. The contractor shall furnish coverage for the full duration of the integrated system test to assist in resolution of any issues uncovered during the test.

Provide certificates of calibration for all sensors required for control and monitoring including temperature and pressure.

Equipment manufacturer:

- The manufacturer shall provide start-up service in the form of a factory trained service technician
- The service technician shall verify correct installation, verify pump systems mounting, verify piping installation, verify control wiring, verify power wiring, and check for proper operation
- The service technician shall provide final adjustments to meet the specified performance requirements
- Fully staffed parts and service personnel shall be within four hours travel from the jobsite

3.11. INSTRUCTION, MAINTENANCE AND O&M MANUALS

O&M Manuals: Upon completion of the work, and prior to training of Owner's personnel, the Contractor shall submit to the Owner complete set of operating instructions, maintenance instructions, part lists, and all other bulletins and brochures pertinent to the operation and maintenance for equipment furnished and installed as specified in this section, bound in a durable binder.

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Contractor shall be responsible for providing proper instruction of the of Owner's personnel for operation and maintenance of equipment, and apparatus installed to be no less than two hours for each piece of equipment. The Contractor shall develop and submit training materials prior to this training. These materials shall include qualifications of the trainer, training agenda, learning objectives, and a written test to be administered at the end of the training session. Operation and Maintenance manuals must present, incorporated and referenced in the training sessions.

The O&M manuals and documentation to include (at least) the following:

- Description of the main design principles
- All calculations to be provided
- An asset register of plant and equipment (describing items of equipment, assets or elements of the work).
- Product information (specifications)
- Document maintenance schedules and tasks
- Spare parts list
- Instructions for its operation and maintenance (including health and safety information and manufacturers' instructions for efficient and proper operation) for all equipment, components and systems.
- Commissioning and testing results.
- A declaration of conformity to be provided
- Guarantees, warranties and certificates.
- Requirements for demolition, decommissioning and disposal
- As-built drawings and specifications
- Help and contact information

3.11.1. Posted operating instructions

Furnish approved operating instructions for systems and equipment indicated in the technical sections for use by operation personnel. The operating instructions shall include wiring diagrams, control diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions where directed. Attach or post operating instructions adjacent to each principal system and equipment including start-up, operating, shutdown, safety precautions and procedure in the event of equipment failure. Provide weather-resistant materials or weatherproof enclosures for operating instructions exposed to the weather. Operating instructions shall not fade when exposed to sunlight and shall be secured to prevent easy removal.

3.12. QUALITY ASSURANCE

If defects are discovered within the warranty period after acceptance by the client, the client will give notice of these defects. The notice of defects shall be deemed to have been given in due time if it is received by the Contractor before the expiry of the guarantee period. The Customer shall set the Contractor a deadline for the rectification of the defects. Should the defined defects not have been remedied by the Contractor within the time limit, the Client shall set the Contractor a second and final shorter deadline for remedying the defects. If the defects are still not remedied, the Client may have the defined defects remedied by third parties at the Contractor's expense.

The Contractor shall take all the points listed in this item into account accordingly when setting the price. Repeated specifications and requirements are only described in this chapter and not in the individual chapters of the bill of quantities.

Perform Work in accordance with code for installation of piping systems for welding materials and procedures or local standards and requirement.

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Perform Work in accordance with authority having jurisdiction and for welding hanger and support attachments to building structure.

Testing, adjusting and balancing:

- Calibration of Testing Instruments: All measurement instruments used for testing, adjusting, balancing, and commissioning shall be calibrated. The time between the most recent calibration data and the final test report date shall not be over 6 months
- Testing and balancing agency, as part of its contract, shall act as authorized inspection agency responsible to Consulting Engineer and Owner, and shall list all items that are installed incorrectly, require correction, or have not been installed in accordance with contract Drawings and Specifications, pertaining to air distribution, cooling and heating systems. The testing and balancing agency is required to provide written reports of all deficiencies and proposed recommendations to the Owner' Representative, Contractor, Architect and Engineer
- The General and Mechanical Contractors shall cooperate with the selected testing and balancing agency in the following manner:
    - The various system installers, suppliers and contractors shall provide all required materials, labour and tools to make corrections when required without undue delay. Install balancing dampers as required by testing and balancing agency
    - The contractor shall put all heating, ventilating, air conditioning and fuel systems and equipment into full operation and shall continue the operation of the same during each working day of testing and balancing
    - Testing and balancing agency shall be kept informed of any major changes made to the system during construction and shall be provided with a complete set of Record Drawings.
    - The General Contractor shall make space and other facilities available to the testing and balancing agency to enable their work to progress. The General Contractor shall schedule the work of other trades to avoid conflicts with this work
- General: Do not proceed with testing, adjusting and balancing work until the following conditions have been met:
    - Work has been completed and is operable. Ensure that there is no latent residual work yet to be completed on the tested equipment
    - Work scheduled for testing, adjusting and balancing is clean and free from debris, dirt and discarded building materials
    - All architectural openings (doors, windows, and other openings) which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal states
    - All related mechanical systems which may affect the operation of the system to be tested, adjusted, and balanced shall be at their normal operating conditions

Variable Frequency drives:

- Supplier of VFD shall be solely responsible for assuring that the VFD shall work properly with the motor(s) being controlled. VFD supplier shall provide all materials and labour required to replace motors, bearing, shafts, etc. that may be incompatible with VFD or become damaged by VFD at no additional cost to the owner. VFD supplier shall reimburse Architect and Engineer at their standard hourly rates for their involvement in resolving failures due to their VFDs
- Manufacturer shall have a minimum of 15 years' experience building similar equipment for controlling the speed for induction motors and at least one hundred successful installations with a variety of VFD sizes and applications
- To ensure quality and minimize failures the VFD(s) and connected motor(s) shall be by one manufacturer. To reduce the known problem of bearing failures by "fluting" the VFD switching

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rates shall be 6-8 Khz wherever possible. Manufactured VFDs at switching rates of 12-15 Khz shall be accompanied by an additional extended warranty to cover bearings and motors to a period of ten (10) years. Should it be impossible to provide matched motor and VFD's provide a shaft grounding system for the driven motor. Acceptable manufacturer is Shaft Grounding
- To ensure quality and minimize infantile failures at the job site, the VFD shall be burned in at the factory at an ambient of 40°C minimum for at least 8 hours. The VFD shall be operating a dynamometer and the load speed shall be cycled during the test. All optional and special features shall be functionally tested at the factory for proper operation.

3.13. WARRANTY

The warranty requirements in the project general terms and conditions are leading. If not mentioned the following warranty conditions should apply:

- All equipment shall be provided with a minimum one-year warranty to include parts and labour. Refer to individual Equipment Specifications for extended or longer-term warranty requirements
- Provide complete warranty information for each item, to include product or equipment, date of beginning of warranty or bond; duration of warranty or bond; and names, addresses, telephone numbers and procedures for filing a claim and obtaining warranty services
- The warranty shall include parts, labour, travel costs, and living expenses incurred by the manufacturer to provide factory authorized service
- Service during warranty period: Contractor shall provide maintenance as specified elsewhere during the 12-month warranty period

Additional warranty requirements:

- Furnish five-year manufacturer warranty for Valves excluding packing
- Furnish five-year manufacturer warranty for leak detection and location system
- Furnish five-year manufacturer warranty for Pumps
- Furnish five-year manufacturer warranty for Tanks
- Furnish five-year manufacturer warranty for Compressors
- Furnish five-year manufacturer warranty for Heat Exchangers
- Furnish five-year manufacturer warranty for Control Boards
- Furnish five-year manufacturer warranty for Variable-Speed Fan Motors
- Furnish two-year manufacturer warranty for Variable-Speed Drives

3.14. GUARANTEE

The Guarantee requirements in the project general terms and conditions are leading. If not mentioned the following guarantee conditions should apply:

- The Contractor shall guarantee and service all workmanship and materials to be as represented by him and shall repair or replace, at no additional cost to the Owner, any part thereof which may become defective within the period of one (1) year after the Date of Final Acceptance, ordinary wear and tear excepted
- Contractor shall be responsible for and pay for any damages caused by or resulting from defects in his work

3.15. LABELLING OF COMPONENTS

All mechanical components, including OFCI equipment have been coded on the schematic and model design according to the latest naming convention.

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For labelling of components in the field the ‘’Label convention for assets’’ need to be applied. The following positions needs to be visible on the labelling:

- Space ID or room name
- Class path asset
- Count

The type of the labels needs to be in accordance with the client specification, e.g.:

- Label material
- Text style
- Text height
- Colours

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4. SPECIFICATIONS

4.1. DESIGN CRITERIA

The following illustrates the criteria underlying the executive design on which the system choices described below are based:

- Energy saving: particular attention has been paid to the containment of energy consumption by adopting architectural solutions that involve the use of materials aimed at reducing to a minimum the dispersion by transmission and the direct radiant effect of transparent surfaces, in synergy with the proposed plant solutions that involve the adoption of equipment and systems capable of ensuring high performance.
- Management and implementation costs: the containment of management costs is one of the fundamental aspects that have guided the systems choices, favoring the solutions described in the following points of this report, with particular attention to the safety and functionality of the systems.
- Partialization: all systems are designed to allow the total hydraulic partialization of IT services and of air conditioning zone by zone, in order to allow only the use of the circuits actually used, regulate the supply flow temperatures to the devices and the relative flow rates according to specific needs, significantly reducing management and maintenance costs.
- Maintenance cost - standardization of components: particular emphasis is given to the aspect of simplification of routine maintenance operations, redundancy, the possibility of identifying any faults and the speed of intervention, which are often sources of very serious inconvenience even for correctly sized systems. Particular attention was given to the total inspectability of the equipment, concentrating them in special compartments and/or dedicated spaces.
- Reliability: the choice of materials, the simplicity of operation of the systems, the intervention logics were aimed at maximum reliability.
- Flexibility: the choices of the proposed plant typologies allow for even substantial changes to the possible variations of internal layout, type of equipment to be powered, diversified temperature control for each individual plant. The system philosophies and the quality of the components to be adopted will be chosen to obtain the best possible performance, in coordination with the needs of the Client, of functionality and of environmental well-being and healthiness.

Particular attention is paid to the design of mechanical systems dedicated to the data center areas, the so-called critical systems. In addition to the already mentioned technical aspects, the design of those systems includes the choice of low energy consumption equipment in order to obtain the maximum energy efficiency of the entire system during every period of the year, minimizing the PUE.

The design of the critical mechanical systems is developed according to the following design principles:

- Concurrently maintainable: a redundant delivery path for power and cooling is added to the redundant critical components so that each and every component needed to support the IT processing environment can be shut down and maintained without impacting IT operations. In other words, the data center requires no shutdowns for equipment replacement and maintenance;
- the system as designed will be able to have an automatic response to some faults (such as an electrical grid failure).

4.2. GENERAL SPECIFICATION

Furnish and install all new material, equipment, and apparatus hereinafter specified unless specifically noted otherwise. All material, equipment, and apparatus shall be identified by the manufacturer's name, nameplate, and pertinent data.

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All materials, equipment, and apparatus are mentioned as standards unless noted otherwise. The words "or approved equal" shall be subsequent to all manufacturers' names used herein, unless specifically noted that substitutes are not allowed.

4.3. CRAH

CRAH perimeter cabinet type cold-only hydronic precision air conditioner for vertical installation, in configuration with bottom displacement air delivery. Made up of two modules, the first containing the heat exchange battery and the second containing the ventilation section. Composed of a structure and paneling in galvanized sheet metal and powder coating, internal panel lining with sound-absorbing material, ventilation units with backward curved centrifugal fan of the plug-fan type, coupled with EC electric motors with external rotor of the brushless type (power supply 400 V / 3 ph / 50 Hz) with inverter for continuous variation of the rotation speed, standard G4 type filter section, electrical panel, motorized PICV regulation valve. Complete with the following accessories: BACNET serial card, dirty filter sensor, dual power supply with ATS, water outlet sensor, optimized battery. Including starters.

For detailed performance parameters refer to the design data document.

4.4. PRESSURIZATION AND DEGASSING UNIT

Pressure maintenance units with pumps, system replenishment and integrated cyclonic vacuum degassing for heating and cooling systems. Consisting of:

- Control unit for pressure maintenance with range + or – 0.2 bar, 2 pumps, 1 overpressure valve and 2 motorized valves for degassing and pressurization, 1 overpressure valve for pressurization of load peaks. For water replenishment 1 solenoid valve and 1 water meter. Including anti-condensation insulation
- Main expansion vessel with content measurement foot, including assembly set for water connection
- Discoidal static absorption vessel

For detailed performance parameters refer to the design data document.

4.5. SIDE STREAM FILTRATION

Supply and installation of continuous filtration units for cooling systems. Consisting of:

- No. 1 centrifugal pump with cast iron body and impeller, flow rate 32 m3/h and head 17.5 m, absorbed power 4 kW, power supply 400 V / 3 ph / 50 Hz, rotation speed 1450 rpm, class F, IE3 motor
- No. 1 stainless steel container for the filtering sections, with DN65 flanged hydronic connections, drain connection and no. 2 connections for pressure gauges, no. 3 PP bag filters measuring 2 x 50 micrometers
- Stainless steel AISI 304L dosing pot, lt.20, installed on the skid
- No. 2 DN65 butterfly valves, no. 2 anti-vibration joints, no. 1 differential pressure gauge for dirty filter warning
- AISI 304L stainless steel pipes
- No. 1 control panel with alarm, including monitoring from BMS via MODBUS and I/O IP alarm contact

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For detailed performance parameters refer to the design data document.

4.6. DX UNIT

Precision air conditioner with direct expansion in split system version for cooling technological environments, with evaporating unit for internal installation and condensing unit for external installation, R32 refrigerant. Composed of:

- Internal evaporating unit in steel sheet and thermo-acoustic insulation in expanded polyethylene, filtering section with COARSE 50% efficiency, finned pack exchanger with copper pipes and aluminum fin, stainless steel condensate collector and flexible PVC gravity drain, temperature probes on air intake for control and regulation, electronic expansion valve with control driver, safety pressure switch and pressure transducers, double centrifugal fan with double suction coupled to an external rotor electric motor

- Control system with microprocessor with display for monitoring operating and alarm status, with internal memory and provision for connectivity card

- External condensing unit in painted steel sheet, thermal and acoustic insulation in expanded polyethylene, finned pack exchanger with copper pipes and high efficiency aluminum fins, axial fan with AC electric motor, rotary scroll compressor with brushless inverter motor

- All exposed copper refrigerant piping (liquid and gas lines) shall be installed inside an insulated protective duct. The duct must provide mechanical protection against environmental damage (e.g., weathering, physical impact). Joints and terminations shall be sealed.

For detailed performance parameters refer to the design data document.

4.7. VRF SYSTEMS

VRF system. Consisting of:

- No. 2 external air source heat pump in vertical flow configuration, single module and with double inverter fan on the module, with external structure in galvanized sheet metal, exchange battery arranged on 4 sides, hermetic inverter compressor, power supply 400 V / 3 ph / 50 Hz. Including pre-charge of R32 refrigerant gas. Cooling performance unit 1 (standard conditions internal T 27 °C, external T 35 °C): cooling capacity 89 kW and EER 6.3; Heating performance unit 1 (standard conditions internal T 20 °C, external T 7 °C): heating capacity 77 kW and COP 4.1. Cooling performance unit 2 (standard conditions internal T 27 °C, external T 35 °C): cooling capacity 83 kW and EER 6.4; Heating performance unit 2 (standard conditions internal T 20 °C, external T 7 °C): heating capacity 62 kW and COP 4.2.
- No. 8 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 1.7 kW; heating performance in standard conditions 1.9 kW
- No. 1 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 2.2 kW; heating performance in standard conditions 2.5 kW

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- No. 3 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 4.4 kW; heating performance in standard conditions 5.0 kW
- No. 1 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 5.5 kW; heating performance in standard conditions 6.3 kW
- No. 5 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 7 kW; heating performance in standard conditions 8 kW
- No. 6 ducted indoor units for installation in false ceilings with medium prevalence at low height (200 mm), with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 11 kW; heating performance in standard conditions 12.5 kW
- No. 3 4-way blow ceiling suspended unit with external finish in insulated galvanized sheet metal, exchanger with copper pipes fined in aluminum, double low-noise fan with DC motor, PP air filter, with adjustable static pressure and air flow. Cooling performance in standard conditions 7.9 kW; heating performance in standard conditions 9 kW
- No. 1 Biddle air curtain, cassette, 2500 mm
- No. 1 centralized controller with LCD touch screen and no. 20 remote controls
- Branch joints

Including technical service for start-up.

4.8. PIPEWORK

4.8.1. Fuel pipework

A double walled HDPE piping system shall be provided with external containment as per the specification sheet or accepted adequate system of piping which shall be provided with a secondary leak containment either with double skin, bund or drip tray. All above ground pipework and where the pipework is exposed and has potential to be in contact with flames or hazardous products shall be single walled system with leak containment underneath.

Product Compatibility: All components of the piping system shall be compatible with the products to be stored, and shall be made of non-corrosive materials, or if metallic, such as the fittings and couplings, isolated from corrosion causing agents.

Structural Integrity: The outer tertiary containment system shall be of such design and materials to have sufficient strength to withstand the maximum burial loads and tested. The double-wall inner primary piping system shall be capable of withstanding liquid pressure five times greater than the designed operating pressures.

Integrity Testing: The double walled pipework's outer secondary containment system shall undergo a pressure hold test of 4 bar after installation and before the final backfill. The inner primary piping system shall be subject to a 10 bar pressure hold test prior to final backfill.

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Monitoring Capability: The design of the secondary containment system shall permit any leak in the primary piping system to be detected by a leak detection system.

Aboveground Terminations: Where pipework transition from buried to aboveground, the secondary containment pipe shall be terminated by installation of a slip closure, riser pipe and stub flange or female BSP adaptor to allow connection to metallic pipework.

Belowground Terminations: Where pipework enters below ground access chambers, the secondary containment pipe shall be terminated by installation of a slip closure and a compact flange adaptor with BSP thread to allow connection to metallic pipework. These access chambers shall meet the following requirements:

- Provide product-tight connection
- Provide product-tight pipe and conduit exits
- Provide sufficient strength to keep out surrounding backfill material
- Made of non-corrosive, product-compatible and dielectric materials

Pipework shall be run neatly, parallel to walls or grid lines on plan and shall, where necessary, set around columns and projections.

All screwed and flanged joints shall be easily accessible.

Pipework passing through internal or external dry sheet construction walls shall pass through formed holes of such size that the pipework may be removed without cutting or deforming the pipe. All holes through such walls shall be closed after the erection and testing of the pipework.

4.8.2. Cooling pipework

Cooling pipework shall be aligned with the pipework specifications and meet the following requirement:

- Welded black steel piping
- Critical cooling pipes <DN200: EN 10255-1 heavy series
- Critical cooling pipes DN200/250: EN 10216, 6,3 mm thickness
- Surface of pipework shall have corrosion protection as per EN ISO 12944: Corrosion class C3 (Medium) / Durability: High (>15 years)
- No press fittings are allowed
- No fittings to be cast in concrete

4.8.3. Pre-conditions Grooved coupling

Grooved couplings can be used as an alternative for the welded black steel piping as per the pipe work specification. To use this type of connections the following requirements needs to be fulfilled:

- Victaulic Pipe, couplers, and associated equipment pieces such as valves, bends, T-pieces etc should be used. Only Victaulic QuickVic connections can be used:
    - Victaulic Rigid couplings style 107 and W07
    - Victaulic Flexible couplings stype 177 and W77
- Grooving must be done by Victaulic grooving tools model 5200i
- Victaulic valves, strainers and suction diffusors are acceptable to be used in this system.
- Design of connection types and thermal expansions provisions should be done by Victaulic
- Design of all pipe supports should be done by Victaulic and send to the EOR for approval prior any constructions work. The contractor shall be implementing the support type and positions into the shop drawings and 3-D model

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- The whole piping system shall me modelled based on the original design by Victaulic. The contractor shall be implementing the pipe system into the shop drawings and 3-D model
- All connections and prefab elements should made in the Victaulic factory
- The number of joint in equipment connections should be reduced by using Victaulic Equipment Modules. If this can not be done welded branches should be used. The final decision of using grooved couplings or welded connections in the equipment branches is depending on the number and positions of the connections and is always up to the EOR and client
- Before construction work start all personal involved should be trained and certified by Victaulic. Certification should be visible on all involved construction workers
- A representative of Victaulic should be on-site during the whole installation, pressure testing and cleaning and flushing period for supervision and quality control
- All connections need to be tagged, labelled, and signed off by a Victaulic inspector. All inspected coupling and their conditions will be record in an inspection log
- A detailed report consisting of observations on the installed conditions of the pipe work and couplings will be handed over to the client
- The contractor is obliged to hand over a fully Victaulic certified installation

4.8.4. Pre-conditions composite piping

Composite piping can be used as an alternative for the welded black steel piping as per the pipe work specification. To use this type of pipe material the following requirements needs to be fulfilled:

- The composite piping consists of a blend of thermoplastic and glass fibre reinforcement
- Pipe should of the Oxygen Tight (OT) type. A special coating needs to be applied to create the oxygen tight layer
- The pipe needs to be protected against exposure to UV radiation. When used in an exposed to UV radiation environment a UV-resistant layer of polyethylene needs to be used
- When colour painting is required an epoxy painting can be used
- In case fire resistant walls or floor are crossed fire retardant seals needs to be used with the same fire resistance classification. The following products can be used:
    - Rockwool Fire protection pipe shell Conlit 150U
    - Flamco fire protection sleeve AWM II
- To prevent freezing of the medium, it is possible to apply tracing, as long as the maximum surface temperature of the MF-RP pipe material does not exceed 70 °C
- The whole piping system shall me modelled based on the original design by the supplier. The contractor shall be implementing the pipe system into the shop drawings and 3-D model
- The details of the system design such as pipe support positions and type, expansion provisions, connection locations and prefab details should be done by the pipe supplier
- All connections and prefab elements should made in the supplier factory or workshop
- The pipe and pre-fabrication pieces should be cleaned and protected before transported to the construction site
- All staff involved in the construction of the system should be instructed and certified by the manufacturer. Certification should be visible on all involved construction workers
- A representative of the supplier should be on-site during the whole installation, pressure testing and cleaning and flushing period for supervision and quality control
- All connections need to be tagged, labelled, and signed off by a supplier inspector. All inspected connections and their conditions will be record in an inspection log
- A detailed report consisting of observations on the installed conditions of the pipe work and couplings will be handed over to the client
- The contractor is obliged to hand over a fully certified installation

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4.8.5. Installation – Steel

Black steel sizes up to 40 mm (DN40) shall be threaded and 50 mm (DN50) and above shall be welded. No threaded connections in pipes containing ethylene or propylene glycol anti-freeze agents shall be used.

Threaded Joints:

- Screw threads shall be clean and true
- In addition, all internal threads shall be checked for quality and any with any indication of damage shall be rejected and removed from site. All pipes shall be reamed or scraped to remove internal burrs after threading

Welded Joints:

- Welding shall generally be in accordance with the relevant Section of the General Specification. All steel elbows shall be of long radius pattern except where space conditions do not permit
- The substitutions of short radius elbows shall be approved by the Clients representative
- For branches smaller than two DN sizes, tap connections are permitted, otherwise manufactured T-pieces shall be used

Welding Piping:

- Where so shown on drawings, specified or directed, welded joints, outlets and flanges shall be used. Welded joints may also be provided elsewhere, where approved by the Clients representative, except on piping smaller than DN50, or at points where it may be explicitly specified or directed to leave flanged joints in order to facilitate future changes
- All welded joints (except pipe welded end-to-end) shall be made by use of forged one-piece welding flanges, caps, nozzles, elbows, branch outlets and tees as appropriate.
- Cut samples shall be submitted for approval if directed. All such fittings etc., shall be of type which maintains full wall thickness at all points, ample radius and fillets, and proper bevels or shoulders at ends. In a prefab workshop, also stubs may be used for branches if possible. All job welding shall be done by the electric arc welding process
- All joints shall be of the 30-degree bevel type. Pipe shall be mill-bevelled or machine-bevelled under this section of the specifications. All scale and oxide shall be removed with hammer, chisel or file and the bevel left smooth and clean
- Pipe lengths shall be lined up straight with abutting pipe ends concentric

Both conductors from the welding machine shall be extended to locations at which welding work is being done. The leads from welding machine to locations of welding works shall be held together with tape or other approved means to prevent induced current in structural steel, in piping or other metals within the building.

The ground lead shall be connected to the length of pipe with a suitable clamp in such manner that the welding current will not flow through joints in pipe, structural steel of building or steel pipe supports.

Weld metal shall be thoroughly fused with the base metal at all sections. Welds shall be of sound metal, free from laps, slag inclusion or other defects.

All welders shall be certified as indicated on their “Welding Qualification Records (WQR) for the service for which they are employed and on which they work. These WQR must be handed over before start welding on site. For welders in a prefab shop, the WQR must always be available and

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must be handed over at the end of the works for all welders worked on the project together with the welding traceability records.

Wherever welded piping connections to equipment, valves, or other units need maintenance, servicing, or require possible removal, the connection joint shall be flanged. Pressure rating of the pipe flanges shall match the pressure rating of the flanges on the equipment to which the piping connects.

4.8.6. Quality of welding

The quality of welding should comply with the following standards:

- EN-ISO 15614-1: *Specification and qualification of welding procedures for metallic materials*
- EN-ISO 5817 class C: *Welding - Fusion welded joints in steel, nickel, titanium and their alloys – Quality levels for imperfections*
- EN-ISO 15607: *Specification and qualification of welding procedures for metallic materials*
- EN 287-1/ISO 9606-1: *Qualification test of welders — Fusion welding*
- EN ISO 17636-1 (formerly EN 1435): *Non-destructive testing of welds - Radiographic testing of welded joints*
- ISO 10675-1/ EN 12517-1 level 2: *Non-destructive testing of welds - Part 1: Evaluation of welded joints in steel, nickel, titanium and their alloys by radiography - Acceptance levels*
- ISO 9712: *Non-destructive testing — Qualification and certification of NDT personnel*
- ISO 3834-2: *Quality requirements for welding*

Welding Co-ordination:

- The welding technologist from the Main contractor is responsible for welding co-ordination. The welding technologist is also responsible that the welding qualification test are in accordance EN-ISO 15614-1

Approvals:

- The Welding Procedure Specification (WPS), Welding Procedure Qualification (PQR) shall be approved by the Main contractor and by the Clients representative prior to start of production welding
- The Welding Procedure Specification (WPS) shall contain all information required by EN-ISO 15607-1

Lack of penetration:

- Butt welds shall be complete joint penetration groove welds unless noted otherwise
- All welds must be 100% visual checked and meet the visual acceptance criteria of NEN-EN-ISO 5817 class C and shall be free from cracks, overlaps, and other weld imperfections

Radiographic Examination:

- Radiographic Examination shall be carried out according: EN ISO 17636-1 class B formerly EN 1435-B and ISO 10675-1/ EN 12517-1 level 2
- Random examination: radiographic examination shall be carried out on the complete welds. Ten percent of all welds shall be tested by X-ray, by an independent party. For example: 10% of random RT i.e. two complete welds out of twenty for each welder

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- Reports must provide description of the test method, evaluation criteria and procedures. All cost for testing and reporting to the Main contractor of this project
- If the weld reject ratio (= number of defective welds divided by number of inspected welds) per welder or welding Operator exceeds 5%, extent of NDE (Non Destructive Examination) shall be increased to 100% and shall stay at 100% until the reject rate per welder or welding Operator drops below 5% and stays there for five consecutive working days

Qualification of NDT personnel:

- The operators in charge of Radiographic Examination may be certified Level 1 to EN 473, ASNT, or equivalent (certification delivered by an independent body). Interpretation must be carried-out by operators certified Level 2 to EN 473, ASNT, or equivalent (certification delivered by an independent body)
- The QC technologist shall endorse all NDE reports

ISO 3834-2:

- The main contractor must proof to fulfil the quality requirements for welding according ISO 3834-2
- The main contractor shall provide qualified personnel and all equipment, tools, instrument, etc. Necessary to carry out qualification of welding procedures and welders, handling, fabrication, welding, welding inspection, installation, and testing

4.8.7. Pipes and fittings

Fittings must be installed in such a way that no damage can be done to other equipment due to leakage of connections or stuffing boxes or glands.

Fittings shall be installed with the spindle in a horizontal position, where possible, to avoid desiccation of the packing material.

4.8.8. Piping specialties

General:

- Provide factory fabricated piping specialties recommended by manufacturer for use in service indicated. Provide piping specialties of types and pressure ratings indicated for each service or provide proper selection to comply with installation requirements. Provide sizes as indicated, and connections, which properly mate with pipe, tube, and equipment connections. Where more than one type is indicated, selection is installer's option

Pipe Escutcheons:

- Provide pipe escutcheons as specified herein with inside diameter closely fitting pipe outside diameter, or outside of pipe insulation where pipe is insulated. Select outside diameter of escutcheon to completely cover pipe penetration hole in floors, walls, or ceilings; and pipe sleeve extension, if any. Furnish pipe escutcheons with nickel or chrome finish for occupied areas, prime zinc base paint finish for unoccupied areas
- Pipe Escutcheons for Moist Areas: For waterproof floors, and areas where water and condensation can be expected to accumulate, provide stainless steel, cast brass or sheet brass escutcheons, solid or split hinged
- Pipe Escutcheons for Dry Areas: Provide stainless steel escutcheons, solid or split hinged

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Dielectric Waterways:

- To effectively isolate ferrous from non-ferrous piping (electrical conductance), prevent galvanic action, and stop corrosion
- Steel to copper, with thermoplastic dielectric lining
- Connection: screwed, grooved, sweat, or flanged to match pipe.
- Dielectric Flanges: Provide dielectric flanges and dielectric bolt sleeves for flanged transitions between dissimilar metal piping. Watts Series 3100 or approved equal

Unions:

- Unions shall be of type specified in following schedule:
    - Black Steel, 1-1/2” (DN40) and smaller: screwed malleable iron, ground joint, brass to iron seat
    - Black Steel, 2” (DN50) and larger: cast iron screwed flanged, flat faced, full faced gasket
    - Stainless Steel, 2” (DN50) and smaller: 16 bar maximum operating pressure, threaded union, with Vic Press 304™ ends
    - Soldered Copper or Brass Pipe, 2” (DN50) and smaller: cast bronze or copper, ground joint, non-ferrous seat with soldered ends
    - Screwed Copper or Brass Pipe, 2” (DN50) and smaller: cast brass, ground joint, brass to brass seat, with threaded ends
    - Flanged Copper or Brass Pipe, 2-1/2" (DN65) and larger: two (2) cast bronze flanges
    - Where grooved joint piping systems are utilized, unions are not required. Grooved joint couplings shall serve as unions

Flanges:

- Provide flanges at flanged connections to equipment, tanks and valves. Faces of flanges being connected shall be alike in all cases. Connection of raised-face flange to flat-faced flange not permitted
- Type of pipe and corresponding flanges as follows:
    - Screwed Black Steel Pipelines: 50 kg. black cast iron screwed flange, flat faces
    - Stainless Steel Pipe, Class 150 stainless steel flange adapter with carbon steel back-up flange and Vic Press 304™ end
    - Welded Steel Pipe, 60kg. black forged steel welding flanges, 1/16" raised face. Use flat face when connected to flat faced companion flange

Flange Gaskets:

- Type: full faced or flat ring to suit flange facings
- Shall conform to ASTM F-104 or another relevant European standard
- Minimum thickness: 1/16”
- Flange gaskets for medium and high-pressure steam service shall be provided with metallic rim

Pipe Sleeves:

- All penetration through a fire or smoke resistant separation shall be compliant with the local standard approved method
- For non-rated sleeve penetrations pack the annular space between the pipe and sleeve with fiberglass and/or mastic
- Sleeves shall provide a minimum ½ inch annular clearance around pipe

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- Sheet metal: Fabricate from galvanized sheet metal; round tube closed with snap lock joint, welded spiral seams, or welded longitudinal joint
- Steel pipe: Fabricate from Schedule 40 galvanized steel pipe; remove burrs
- Iron pipe: Fabricate from cast iron or ductile-iron pipe; remove burrs
- Plastic and copper pipe: Fabricate from Schedule 80 PVC plastic pipe; remove burrs
- Sleeves through interior concrete walls and floors: Telescopic, submerged, adjustable sleeves. Floor sleeves to extend a minimum of 1” above finished floor
- Through exterior walls and floor on grade: 60 kg class cast-iron pipe sleeve. Where waterproof membranes are used, provide membrane clamps. For insulated piping, sleeve diameter shall not be less than diameter of insulated pipe

Sleeve Seals:

- All sleeves shall be sealed to prevent intrusion of moisture, dust or insects
- Underground: For sleeves passing through exterior or foundation walls, provide mechanical link seal assembly
- Aboveground: For sleeves passing through walls or floors provide a non-toxic 3-hour rated fire resistant silicone foam sealant with a Flame Spread Rating of 20. Sealant to be tested and approved under local codes and requirements. All fire rated penetrations shall be sealed with approved system and should be certified
- Local Approvals: All seals to be provided shall be in accordance with the regulations of all governing agencies of the city, county, and fire brigade
- Valve Boxes: Concrete body, cast iron cover with vandal resistant screws, extensions as required to extend full depth to valve. Valve box cover lettering shall correspond to the valve service, "Water", "Gas", "Fire", "Sewer"

4.8.9. Expansion compensators and flexible piping connections

General:

- Pipe expansion, in general, is to be absorbed in bends, swing joints, expansion loops, and offsets. All piping mains, branches and runouts shall be installed to allow for free expansion and contraction without developing leaks or undue stressing of pipe. Vertical piping for domestic hot water, chilled water, heating water, steam and steam condensate shall be provided with expansion joints at each floor if required based on expansion. Expansion products to conform to the standards of the Expansion Joint Manufacturer's Association. Expansion joints on large bore piping shall be balanced so as not to exert any reaction force. Expansion joints shall not require packing. Installer shall select materials and pressure/temperature ratings to suit intended service. Select pack less expansion joints to provide 150% absorption capacity of calculated maximum piping expansion between anchors. All connections shall have ends to match piping system application. Calculate axial forces caused by compensators in pressurized pipes and provide sufficient slide and anchor points
- Expansion Compensators (Pipe Compression and Extension): Multiple stainless-steel bellows and stainless-steel liner with shroud and end fittings
- Flexible Expansion Joint/Seismic Connector for Steel Pipe: Stainless steel hose and braid, 180° return, CSA approved, and end fittings
- Flexible Connection for Steel Pipe (Piping and Equipment Located Outside the Building): Stainless steel hose and braid, with threaded or flanged ends
- Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source.
- Flexible Connection for Copper Pipe: Bronze hose and braid, copper tube ends
- Provide steel supports to prevent sagging is required

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- Flexible Rubber Connectors (Pump Connections): Concentric spool type expansion joint, single or double arch. Chlorobutyl tube and cover. The body shall be reinforced with rectangular body rings and a minimum of six bias plies of polyester fabric. A hypolon coating shall be applied completely and uniformly to the cover:
    - For heating hot water service and critical pump connections. Furnish with fluor elastomer tube. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/Kevlar fabric
    - Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension. Manufacturer shall provide documentation utilizing oven aged and cold flexibility tests to verify elastomer capability
    - For chilled water, condenser water, and non-critical pump connections. Furnish with fluor elastomer tube. The body shall be reinforced with rectangular body rings and six bias plies of fiberglass/Kevlar. Provide galvanized flat (not L shaped) back up rings and control rods to limit maximum axial extension
    - Three grooved joint flexible type couplings may be used in lieu of flexible connectors on steel pipe for vibration attenuation and stress relief. Grooved joint couplings shall be placed in close proximity to the vibration source. For services up to 120°C.
- Expansion Joints for Grooved Piping: For piping systems fabricated from grooved pipe and couplings, use one of the following methods for expansion compensation:
    - Combination Couplings and Nipples: Provide expansion joints constructed of grooved short pipe nipples and flexible couplings, designed by manufacturer to suit intended service. Provide removable ties to hold joint compressed or expanded during piping fabrication, depending on application. Total joint end movement is dependent on the number of couplings/nipples in the joint. Select couplings and gasket materials to match balance of piping system
    - Slip-Type Expansion Joints: Provide slip-type expansion joints constructed of carbon steel pipe and couplings, designed by manufacturer to suit intended service. Joint shall be gasketed expansion joint, with grooved ends. Slide section coated with PTFE modified PPS (Polyphenylene Sulphide) coating. Joint suitable for axial end movement up to 3” (DN80). Select couplings and gasket material to match balance of piping system
- Pipe Alignment Guides: Provide pipe alignment guides on both sides of expansion joints. Guide shall be of carbon steel construction with split guiding cylinder and integral anchor base and internal four finger two-piece spider. Cylinder wall thickness shall be equal to schedule 40 wall thickness of pipe being guided. Spider shall be capable of clamping directly to pipe and moving only in an axial direction while inside cylinder. Anchoring directly to building substrate

4.9. VALVES AND APPENDAGES

4.9.1. General

Valves shall be provided to isolate each item of plant and each main branch.

The Contractor shall make all reasonable attempts to ensure the manufacture of valves is consistent throughout the whole of the installation in order to minimize stock holding of spares.

All valves shall be located to provide easy access for operation and servicing. Control valves shall normally be installed in horizontal lines with stems vertical.

Ball valves shall be used on service pipelines where regulation is required and shall be supplied and fitted in positions indicated. Valves shall be of the same nominal bore as the pipeline in which they are indicated.

Valves shall always be installed in accessible locations to permit easy operation and maintenance.

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Care shall be exercised in the installation of screwed valves to avoid straining their bodies and preventing the gate or seat from closing tight.

4.9.2. Valves

Valves shall be provided and installed where required for the purpose of circulation control and isolation. Valves shall be of full-bore size to suit the service into which they are installed.

All castings shall be clean close-grained metal, free from rough projections. Screwed valves shall have heavy hexagon reinforcement threads, ample length threads and a heavy shoulder to prevent over entry of pipes. Flanged valves shall have flat faced flanges and of thickness conforming to the appropriate specifications for the respective services and drilled off-centre.

General:

- Valve ratings shall exceed respective system operating pressures by 50% (minimum). All valves shall be line size unless otherwise noted
- Valves shall have pressure rating PN 16. Samples shall be provided for inspection of the manufacturing methods

Butterfly valves:

Butterfly valve with flanged LUG body in ductile cast iron EN GJS 400-15 and centered disc in nickel-plated ductile cast iron EN GJS 400-15. Sleeve in EPDM. Painting with epoxy enamel. Adjustable lever in intermediate positions and lockable. Integrated flange according to ISO 5211. For flanges EN1092 and ANSI 16.5#150. Face to face EN 558/1-20. Operating limits -10°C ÷ +120°C. Pmax 16 bar. It can be equipped with actuator, extension for road grip, visual indicator and padlock for manual reducer, micro box, limit switch kit, limit switch box and positioner. Comply with PED directive.

- Up to and DN100mm: hand lever cast iron
- From DN125 to DN400: Worm gear unit with hand wheel
- Outside installed valves shall be weatherproof and resistant to influence of UV-light

Motorized butterfly valves:

Two-way motorized butterfly valve with centered disc and lug-type body in ductile iron, epoxy enamel painting, stainless steel shaft, flanged connections PN16. Suitable for heating and air conditioning HVAC and water treatment and distribution. Control with 24 V electric actuator of the on-off or modulating type.

Ball valves:

The valves will be equipped with a blow-out stem, a lockable locking device and an anti-static device. The construction features will be the following: Body Carbon steel ASTM A216 WCB Stem Stainless steel 316 in blow-out execution Stem seal PTFE packing Ball Stainless steel ASTM A351 CF8 Double recessed PTFE gaskets to absorb temperature variations suitable for differential pressures equal to the nominal pressure Actuation Lever and threaded connections. Diameters from DN 20 to DN 50.

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Threaded Balancing Valves:

Threaded variable orifice static balancing valve with brass body. Internal: brass. Flat seal in EPDM. Handwheel position memory. The inclined seat reduces turbulence and noise. Non-rising stem. Connections for quick-fit pressure or temperature gauges. For ISO 228-1 thread. Operating limits -20°C ÷ +120°C. Pmax 20 bar. Diameters from DN 20 to DN 50.

Flanged Balancing Valves:

Balancing valve flanged with body in grey cast iron EN GJL 250. Interior: brass. Flat seal in EPDM. External and internal painting with epoxy enamel. Position memory of the adjustable handwheel. Connections for pressure or temperature taps with quick coupling. For EN 1092 flanges with ISO 5752 face to face. Available: electronic instrument for measuring flow rate and differential pressure and fittings with quick coupling string. Operating limits -10°C ÷ +140°C. Pmax 16 bar. Complies with the PED directive. Diameters from DN 65 to DN 150.

Threaded Check Valves:

Threaded check valve with body in grey cast iron EN GJL 250. Internal: brass. Spring in AISI 302. Flat seal in FKM. External and internal painting with epoxy enamel. For ISO 228-1 thread. Face to face non-standardized. Suitable for in-line installation and as a foot valve. Available: threaded sockets for drain and bypass. Operating limits -10°C ÷ +150°C. Pmax 16 bar. Minimum back pressure 0.1 bar. Comply with the PED directive.

Flanged Check Valves:

Flanged check valve with body in grey cast iron EN GJL 250. Internal: brass. Spring in AISI 302, flat seal in FKM. External and internal painting with epoxy enamel. For flanges EN 1092. Suitable for in-line installation and as a foot valve. Available: threaded outlets for drain and bypass. Operating limits -10°C ÷ +150°C. Pmax 16 bar. Minimum back pressure 0.1 bar. Comply with the PED directive.

Control valves:

- Pressure stage in drawings (PN): 16
- Control Authority: minimum of 0,3
- Materials:
    - House and gland: brass
    - Diaphragm and O-rings: EPDM
    - Valve cone spring and screws: stainless steels. Operation: Motor Accessories according section controls
    - Measuring devices: Each system, pump, hydraulic section, battery of an AHU, CRAH etc. shall be provided with an orifice for checking the flow
    - Separate contacts for position-indication (open/closed) and controls

All valves shall be:

- Labelled
- Lockable

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Valves shall be “maintenance free”, where good operation of all valves shall be maintained in time; without or with a minimum of maintenance to be done.

Any valves for future connections and hose connections for chillers shall be fitted with a spade and a blank flange, ensuring the valve can be tested for maintenance purposes and to keep fittings wet to avoid dry out.

Product Data:

- Submit manufacturer's technical product data, including installation instructions for each type of valve. Include pressure drop curve or chart for each type and size of balancing valve or circuit setter. Submit valve schedule showing manufacturer's figure number, size, location, and valve features for each required valve

Shop Drawings:

- Submit manufacturer's assembly-type (exploded view) shop drawings for each type of valve, indicating dimensions, weights, materials, and methods of assembly of components

Valve Identification:

- Provide valves with manufacturer's name (or trademark) and pressure rating clearly marked on the valve body

Operators:

- Provide standard handwheel for gate, globe valves
- Provide 90-degree lever operator for ball valves
- Provide valve stem extension for lever-operated valves on insulated piping, so handle will clear insulation
- For valves sizes 2-1/2” (DN65) and larger, located more than 2.4-meter from floor in equipment room areas and mechanical galleries, provide chain operated sheaves. Provide chain and extend down to 1.8 meter above floor and hook clips on chain arranged to clear walking aisles
- For valves sizes 2-1/2” (DN65) and larger, located more than 3-meter from floor in access path for servers (corridor areas), provide chain operated sheaves. Provide chain and extend down to 2.75 meter above floor and hook clips on chain arranged to clear walking aisles
- For valves sizes 2-1/2” (DN65) and larger, located lower than the indicate in equipment room and corridor areas, provide hand wheel gear box operator

4.9.3. Valves for fuel system

Ball valves:

- Two-piece, threaded ends, bronze body, stainless steel ball, reinforced Teflon seats, blow-out proof stem, lever handle, listed for flammable liquids and LPG
- ¼ inch (DN8) to 1 inch (DN25):
    - Full port
- ¼ (DN32) inch to 3 inches (DN80):
    - Conventional port

Check valves:

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- Horizontal Swing Check Valves:
  - 2- ½ (DN65) inches and larger:
    - Cast iron body, bolted cap, bronze or cast-iron disc, renewable disc seal and seat, flanged ends
- Spring Loaded Check Valves:
  - 2 inches (DN50) and smaller:
    - Bronze body, in-line spring lift check, silent closing, Buna-N disc, integral seat, threaded ends
  - 2- ½ (DN65) inches and larger:
    - Wafer style, cast iron body, bronze seat, centre guided bronze disc, stainless steel spring and screws, flanged ends

4.9.4. Thermometers

Bimetallic thermometer in stainless steel with rear stem in stainless steel 316TI for installation in well with suitable reading scale:

- 0 +100°C for pipes with high temperature operation
- 0 +50°C for pipes with low temperature operation

Dial size 44 mm.

4.9.5. Pressure gauges

Pressure gauge built according to UNI EN 837.1 standards - AISI 304 IP65 stainless steel case, diameter 40mm. Transparent polycarbonate - AISI 316 pin and movement - 1/8 gas RADIAL conical connection (ISO 7/1). Aluminum dial with white background - black BAR and Red PSI scale - Accuracy class 2.5% Aluminum pointer.

4.9.6. Strainers

Strainers shall be full line size located ahead of all pumps, chillers, air handling units and in locations as indicated on drawings. Up to 50 mm size bodies shall be bronze, screwed body," Y" type, with 37% open mesh Monel metal screen, and 1.4 mm diameter holes.

Sizes 65 mm and above shall have cast Iron body, flanged, "Y" type bolted cover flange, tapped blow-off outlet, 37% open mesh Monel metal screen, with 1.4 mm diameter holes. Metal screens should have reinforcement rings at both ends.

All separate circulating systems shall be fitted with filters and according to the specifications below:

- Steel cast housing with flanges PN16
- Stainless strainer width 0,25 mm
- Flange lid to remove or maintain strainer
- Lid with drain connection and valve
- Free flow model

4.9.7. Air vents

Air vents shall be installed at all high points in supply and return piping. Air vents shall be equipped with shut off valves.

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4.10. VIBRATION ISOLATORS

All plant and equipment shall be isolated from the building structure in such a way that noise and vibration (in particular seismic vibrations) are not transmitted through the structure.

The anti-vibration equipment must comply with:

- Outside installed vibration isolators shall be weatherproof and resistant to influence of UV-light
- Vibration isolators shall be able to limit horizontal movement but enable vertical movement
- Machines shall be adjusted and balanced whilst mounted on the vibration isolators
- Machines shall be prevented from slipping from the vibration isolator
- Vibration isolators must be applied at all applicable locations, but definitely for chillers, air handling units and all floor mounted pumps

4.11. THERMAL WATER TANKS

Insulated buffer tanks with the following characteristics:

- Material: carbon steel
- Insulation: PU-R/PE, thickness 30 mm
- Coating: PVC
- Operating limits: -10°C + 60°C/6 bar
- Installation: outdoor

For detailed performance parameters refer to the design data document.

4.12. INSULATION

All cooling system pipework shall be insulated with an airtight insulation such as Armaflex AF. All hot water distribution pipes shall be installed with insulation with a minimum thickness as per DPR 412/93. Insulation shall be continuous through supports hence insulation blocks shall be included for all support bracketry. Where pipework is run externally 2x25mm Armaflex with seams interleaved shall be provided with tracing and an aluminum cladding. All joints shall be riveted and sealed with a suitable silicon-based sealant. Where pipework runs horizontally, any longitudinal joints in the aluminum cladding shall be made in the lower quadrant only.

All Insulation material shall be at least class B-S2 / BI-S2 for flame retardant materials or class A-S1 / AI-S1 for non-combustible materials.

Heat distribution and hot water pipes and fittings are to be insulated as follows:

- In the case of lines and fittings with an internal diameter of up to 22 millimeters, the minimum thickness of the insulation layer is 20 millimeters, based on a thermal conductivity of 0.035 watts per meter and Kelvin
- In the case of lines and fittings with an inside diameter of more than 22 millimeters and up to 35 millimeters, the minimum thickness of the insulation layer, based on a thermal conductivity of 0.035 watts per meter and Kelvin, is 30 millimeters
- In the case of lines and fittings with an inside diameter of more than 35 millimeters and up to 100 millimeters, the minimum thickness of the insulation layer, based on a thermal conductivity of 0.035 watts per meter and Kelvin, is equal to the inside diameter

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4.13. FLUSHING

Water:

- Flushing points and drain points shall be incorporated in the pipework system and flushing bypasses shall be included around chillers, coils etc. Flushing velocities will be sufficient to ensure that deleterious material such as welding slag is removed from the pipework system. The flushing velocities must be in accordance with the flushing velocities given in Table 5, BSRIA. Application Guide (AG), Pre-Commission Cleaning of Pipework Systems
- Prior to flushing, all pipework systems shall be pressure tested to at least twice the working pressure with the pressure being maintained for a period of one hour

Fuel:

- All pipe work and equipment shall be cleaned with compressed air

4.14. TESTING AND BALANCING

Test holes:

- Test holes shall be provided as necessary for proper measuring and to balance the system
- Piping shall be capped with materials the same as the piping system
- Insulation shall be neatly hemmed with metal or plastic edging, leaving test points visible for future testing

4.15. WATER LEAK DETECTION AND LOCATION SYSTEM

Manufacturers:

- TTK

Product Description:

- Microprocessor based monitoring unit, sensor cable, probes, system layout map, and auxiliary equipment to provide continuous monitoring of sensing strings for leaks, shorts, breaks, and probe activation. When any of these conditions occur at any point along cable, alarm sounds, type of condition is identified, and location displayed. System monitors interstitial space of double walled tanks and pipework

Performance:

- Detect and identify location of first leak within 0.2 percent of sensor string length or 1.5 meter, whichever is greater. Identify type of alarm
- Sensing String Length: Monitor up to 1.5-meter feet of cable for each sensor string from single monitoring unit
- Multiple Leaks: Detect and locate multiple leaks or additional liquid on sensor cable
- Breaks and Shorts: Identify location of breaks and shorts on cable. When faults occur, sound alarm, and display on front of monitoring unit type of fault and location of fault
- Liquids Detected: Detect liquids, including aqueous, hydrocarbon, conductive, and nonconductive liquids
- Remote Annunciation: Furnish relays for remote indication of alarm conditions. Relays indicate no alarm conditions exist, alarm condition exists but has not yet been acknowledged, and alarm condition exists and has been acknowledged. Communications available via RS-232 and ASCII communication protocols to allow central point monitoring and control via remote computer

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- Archives: Record significant events in non-volatile memory with capacity of 900 events. When memory becomes full, recorded events are deleted from memory on first-in-first-out basis. Each recorded event includes time and date event occurred
- System Status: Continuously give positive indication of monitoring sensing string and status of sensing string. System clock indicates time and date on LCD of monitoring panel. System clock is programmable. Include time and date indication for events recorded in memory
- Security: Assignable password security for varying levels of system access. Minimum of 20 passwords available within system. System to not allow unauthorized modifications to sensing string to be made without causing alarm condition
- Sensor Types: Capable of monitoring sensor cables, probe sensors, and switch sensors such as float switches, and pressure switches, from same monitoring panel. English language displays indicate status of sensors
- Sensitivity: System to not detect incidental liquid contact. Sensitivity field adjustable to increase or decrease amount of wetted cable needed to cause alarm

Components:

- Monitoring Unit:
    - Indicates when liquid comes in contact with sensor cable by sounding alarm, actuating output relays, displaying message leak has been detected and giving location of leak on sensing string
    - Unit furnished with green LED on panel front indicates unit is powered. Furnish two line by forty-character backlit LCD visible from front of unit to provide system data. Red LED on panel front indicates alarm condition has occurred. Unit power requirements: 120/240 VAC, 100 VA, 50/60 Hz, single phase. Equip with RS-232 communication port and minimum of one common and one SPDT output relay for each cable, rated for 250 VAC, 10 amp
    - Enclose in modified NEMA 3 / IP54 type enclosure. UL listed to provide connections for intrinsically safe sensor circuits for use in hazardous locations. Ability to locate leak does not depend on battery backed up functions. In event of power failure, store system conditions and parameters in non-volatile memory allowing unit to automatically resume monitoring, without resetting, upon restoration of power. Furnish on-off switch in panel
- Sensor Cable: Coaxial construction consisting of insulated copper centre conductor, spacer material, and outer braid. Centre conductors not less than 20 AWG for mechanical strength. Cables field repairable

4.16. GLYCOL LEAK DETECTION

To be installed on the roof to spot eventual glycol leakage from chiller free-cooling loops.

Consist of:

- Stainless steel drip trays
- Conductivity sensors able to detect glycol inside water
- Motorized ball valves with open-close control, fail-to-close
- Control box for outdoor installation, with alarm to be reported to BMS.

4.17. MANUFACTURER'S FIELD SERVICES

Pumps:

- The manufacturer shall provide start-up service in the form of a factory trained service technician. The service technician shall verify correct installation, verify pump systems mounting, verify piping installation, verify control wiring, verify power wiring,

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and check for proper operation. The service technician shall provide final adjustments to meet the specified performance requirements. Fully staffed parts and service personnel shall be within four hours travel from the jobsite

Leak detection:

- Furnish factory trained representative of system supplier for 16 hours of on-site time during leak detection and location system sensor and electronics installation
- Furnish factory trained representative of system supplier for 8 hours of on-site time during final checkout of leak detection and location system

Packaged split systems, Package Chiller and Heat pump:

- Train Owner's maintenance personnel on procedures and schedules related to start-up and shutdown, troubleshooting, servicing, and preventive maintenance
- Schedule 4 hours training with Owner, with at least 7 days' advance notice

Aboveground tanks:

- Furnish factory trained representative for 16 hours of on-site time during aboveground tanks installation
- Furnish factory trained representative for 8 hours of on-site time during final checkout of aboveground tanks installation

4.18. AIR HANDLING UNITS (DOAS)

4.18.1. General

All accessible sections shall be provided with lighting fixtures, lighting fixtures to be operated with switch on the outside of the DOAS's.

All control equipment shall be placed in the airstream and need to be accessible with the section.

Condensation connections to be equipped with a special overpressure siphon and shall be connected to the drain system.

The floor of the DOAS's shall be plated with stainless steel, to prevent corrosion.

The equipment manufacturer shall strictly adhere the following standards & specification:

- Energy efficiency requirements for DOAS related 2016 regulations
- ISO 9001 certificate required.
- CEN (Committee European de Normalisation) standards
- SIA 382-1
- Efficiency class IE3 for electrical motors
- DOAS's shall meet the EUROVENT CERTIFICATION requirements of:
  - Casing strength to CLASS 2A
  - Casing air leakage L2
  - Thermal transmittance CLASS T2
  - Thermal bridge factor CLASS TB2

The DOAS manufacturer shall guarantee that no condensation shall take place on the exterior of panels. In the event that any condensation problems appear after installation, the Main contractor shall undertake all remedial measures to rectify and to the satisfaction of the Clients representative. Any stacked or double height coils shall have separate drain pans to reduce carry over.

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Vibration Isolation:

- The Air Handling Unit shall have internal vibration isolation system by mounting fan, motor and drive assembly on spring isolators. The fan discharge shall be connected to the air handling unit casing through canvas connection to prevent vibration transfer. In addition to the above the entire unit shall be mounted on additional vibration isolators

Filter Section:

- Filter cells shall be of standard sizes and shall be obtained from reputed European manufacturer. The filters shall be sealed against the filter frame using a permanently elastic gasket to a standard compatible with the filter efficiency
- Pressure drop tapings shall be fitted to allow manometer or filter monitor to be connected. Filter materials shall be flame-retardant, incombustible, non-odorous and offer no sustenance to vermin. Each filter section has to be provided with manometer

Bag Filters:

- Bag filters shall be high performance extended area disposable type filters Class M5 and F7 (EU7). Each filter shall consist of high-density glass microfiber media with a chemically bonded backer, individual pockets and a corrosion resistant stainless-steel enclosing frame. The filter unit shall be completely factory assembled and shall be classified by underwriter's laboratories
- Pockets shall consist of glass micro fibres chemically bonded to a reinforced backing
- They shall be sewn with a tapered stitch which forms a 'V' or wedge-shaped pocket resulting in uniform velocity in the passages of the air entering and air exiting sides of the filter. The pockets shall be equipped with a minimum of 40 support points per square foot of the filter media. All stitching points shall be completely sealed with foam seal or equivalent. The pockets shall be chemically adhered around the periphery of the galvanized steel retainers
- Retainers shall have rolled edges to reduce possible cuts to media, or lacerations to installers

4.18.2. Fan and fan motor

Fans shall be non-overloading type with galvanized steel casings. Fans shall be tested in accordance with AMCA 300-85 and shall conform ISO 1940/L. Every individual fan shall be run before delivery to check bearing condition and vibration. Impeller should be coated with 60-micron epoxy painting of high quality.

The fan shall be connected to the outlet opening by means of an airtight flexible connection. Fans shall not exceed a maximum outlet velocity of 10 m/s.

The degree of protection shall be IP54 with mounting method B3 and Class F insulation.

Fan bearing shall be re-lubricated type with extended lube lines to terminate outside the fan section. The bearing shall be selected for life of 200,000 Hours operation. Fan drive shall be rated at 150% of the maximum motor power of the units and shall be fitted with adjustable belt tension arrangement. Belt guards or screen protection door in Fan section shall be provided in accordance with CEN Standard.

Each motor that’s driven by a Variable Frequency Drive must be provided with internal thermistors for overload protection and electrical insulated bearings.

The fan motor shall be suitable for operating 400V, 3Ph, 50Hz electrical power supply. The fan motor shall be wired to the safety isolation switch or connection box.

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The Main contractor shall select power input and speed of the fan after ascertaining system static pressure in accordance with pressure drop calculations to the approval of the Engineer.

The fan shall meet the safety requirements of the CE marking.

The motor shall be mounted on a common, torsional rigid, galvanized steel base frame. The fan and motor assembly shall be isolated from the casing by means of spring anti vibration mountings selected to suit the speed of the fan and designed for 90% isolation.

4.18.3. Critical DOAS

Air handling unit for primary air. With the following treatment sections on the delivery line:

- External air intake with on-off motorized damper
- Bag filter (efficiency M5 – ISO Coarse 65%) length 535 mm
- Empty section for maintenance
- Bag filter (F8 – ISO ePM 70%) length 535 mm
- Empty section for maintenance
- Rotary heat recovery unit with thermal efficiency > 75% and enthalpic efficiency > 65%
- Mixing section with motorized damper
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Direct expansion heat exchange battery with copper tubes and aluminum fins in 11 rows, refrigerant type R410A, cooling capacity 53 kW and heating capacity 22 kW
- Electric post-heating battery, thermal capacity 13 kW
- Steam humidification with RTS humidifier, nominal power 20 kW
- Empty section for maintenance
- Air supply with on-off motorized damper

Return line:

- Air return with on-off motorized damper
- Bag filter (efficiency M5 – ISO Coarse 65%) length 535 mm
- Empty section for maintenance
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Mixing section with motorized damper
- Rotary heat recovery unit with thermal efficiency > 75% and enthalpic efficiency > 65%
- Empty section for maintenance
- Air exhaust with on-off motorized damper

Including external direct expansion unit, regulation and control panel on the machine, humidifier, inspection doors and internal lights, stainless steel floor and stainless steel internal frames, regulation and control field elements, connection cables, MODBUS communication to the BMS system.

For detailed performance parameters refer to the design data document.

4.18.4. Admin DOAS

Packaged air handling unit for primary air with fully integrated refrigeration/heat pump cycle and adiabatic heat recovery.

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With the following treatment sections on the delivery line:

- External air intake with on-off motorized damper
- Pocket filter (G4 – ISO ePM 55%) length 50 mm
- Bag filter (F7 – ISO ePM 70%) length 300 mm
- Rotary heat recovery unit with thermal efficiency > 85% and enthalpic efficiency > 65%
- Direct expansion heat exchange battery with copper tubes and aluminum fins in 26 rows, refrigerant type R454B, cooling capacity 49 kW and heating capacity 35 kW
- Steam humidification with RTS humidifier, nominal power 12 kW
- Direct expansion heating battery with copper tubes and aluminum fins in 13 rows, refrigerant type R454B, heating capacity 26 kW
- Electric post-heating battery, thermal capacity 11 kW
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Air supply with on-off motorized damper

Return line:

- Air return with on-off motorized damper
- Pocket filter (efficiency G4 – ISO Coarse 55%)
- Rotary heat recovery unit with thermal efficiency > 85% and enthalpic efficiency > 65%
- Indirect adiabatic cooling for heat recovery
- Direct expansion heating battery with copper tubes and aluminum fins in 10 rows, refrigerant type R454B, heating capacity 26 kW
- EC plug fan with power supply 400 V / 3 ph / 50 Hz
- Air exhaust with on-off motorized damper

Including regulation and control panel on the machine, humidifier, inspection doors, regulation and control field elements, connection cables, MODBUS communication to the BMS system.

For detailed performance parameters refer to the design data document.

4.19. FANS

All fans shall be complete with:

- Manufacturer: see spec sheet
- Type: axial fan for in line mounting with duct
- Aluminium blades
- Thermostatic control variable speed by frequency control when controlled on room temperature (transformer room, mechanical plant room)
- Mounting feet and anti-vibration mountings, for horizontal or vertical operation
- Matching flanges
- Flexible connectors
- Inlet cone
- Isolation switch
- Electrical isolation

Arrows indicating the correct rotating and direction of airflow shall be mounted on the outside of the fan casing.

All fans shall be monitored and controlled.

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For detailed performance parameters refer to the design data document.

4.19.1. Smoke extraction fan

Axial smoke extraction fan for smoke transport with temperature class F400, with vertical flow upwards, with body in steel sheet, painted and thermally insulated, aluminum blades, motorized shutter with watertight closure. Motor with power supply 400 V / 3 ph / 50 Hz, efficiency class IE3, ISO class H, protection IP55. For installation on flat or pitched roofs and assembly with ducted intake and free expulsion. Including the following accessories: thermally insulated roof protection, rain hood, equipotential connection.

4.19.2. Supply fan for smoke extraction system

Horizontal flow axial fan for fresh air supply smoke extraction system, with painted sheet steel body, 9-blade sheet steel impeller. Motor with 400 V / 3 ph / 50 Hz power supply, IE3 efficiency class, ISO F class, IP55 protection. For outdoor installation with free suction and ducted pressure side. Including the following accessories: casing extension with inspection door, duct with damper, mounting feet, equipotential connection.

4.19.3. Wall fan

Axial fan with square frame and air flow from impeller to motor, frame in anti-corrosive material, impeller with wing profile blades in plastic resins, protective net, protected steel motor holder, maximum temperature 50 °C, single-phase motor power supply 400 V / 3 ph / 50 Hz. Including gravity shutter, spacer and protective net.

4.19.4. Inline fan

In-line centrifugal fan for small flow rates, pressed steel casing, epoxy powder coated, high-efficiency, low-noise backward curved blade impeller, plastic box for electrical connections, IP54 protection, maximum temperature 60 °C, single-phase motor, power supply 230 V / 1 ph / 50 Hz. Including silenced box, speed regulator, damper and collar.

4.19.5. Roof-mounted fan

Vertical-throw centrifugal extraction tower for the extraction of stale air, with frame and protective cap in galvanized steel, centrifugal impeller with backward-facing blades in galvanized sheet metal, 4-pole single-phase motor, power supply 230 V / 1 ph / 50 Hz and speed regulator.

4.20. DUCTWORK

Ductwork fabrication and hanging shall be as described in the Italian standards. The ductwork systems (air ducts, plenums, casings etc.) shall be constructed of lock performing galvanised steel sheets and complete with all necessary dampers, silencers/attenuators etc.

Ductwork shall be installed in a workmanlike manor and shall facilitate maintenance of all item’s op plant and equipment. The ductwork shall not create obstructions to the free movement of personnel.

During installation the open ends of ducts shall be protected with blank, flanged sheet metal baffles, securely attached to prevent debris and dirt from entering.

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At each main branch of the ductwork and at each fan discharge and suction the Main contractor shall provide sufficient number of test holes to allow balancing. Test holes shall also be provided at all equipment.

General requirements:

- Construct all ducts and plenum of gauges, and with joints, bracing, reinforcing, and other construction details in accordance with the latest construction standards previously listed
- Duct dimensions indicated on drawings are net, inside, clear dimensions. For internally lined ducts, add lining thickness to determine metal duct dimensions
- Ducts shall be constructed of material gauges and reinforcement to meet 150% of the pressure requirements for external static pressure scheduled on drawings for the fans serving each system
- Internal insulation is not allowed

4.20.1. Sheet metal material

General Material Requirements: Comply local Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

Galvanized Sheet Steel:

- Galvanized Coating Designation: G90
- Finishes for Surfaces Exposed to View: Mill phosphatized

Tie Rods: Galvanized steel, 6mm minimum diameter for lengths 900mm or less; 10mm minimum diameter for lengths longer than 900 mm.

4.20.2. Ductwork fabrication

Joints – Sealant:

- Outdoor ductwork: Solvent-based and oil-based sealants
- Indoor ductwork: water-based sealant. Flexible, adhesive sealant, suitable for high velocity and high-pressure applications

Hard cast Iron Grip.

Two-Part Tape Sealing System: Woven-fiber tape impregnated with gypsum mineral compound and modified acrylic/silicone activator to react exothermally with tape to form hard, durable airtight seal.

Joints - Rectangular Ducts:

- Slip drive joints, standard seams, flanges or welding

Joints – Round:

- Exposed Ductwork: Slip drive and sheet metal screws
- Concealed Ductwork: Sheet metal screws

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Elbows:

- Construct long radius elbows with center line not less than 1.5 times the duct width. Shorter radius elbows may be used where required to fit in restricted spaces, or as shown. Provide single thickness turning vanes on all short rectangular radius elbows less than 25" wide. Provide double thickness turning vanes for short rectangular radius elbows 25" wide and greater. Elbows with square throat and radius heel are NOT allowed

Transitions:

- Construct transitions with minimum slope of 1 to 5 ratio

Branch Connections:

- Provide 45° entry boots or radius taps for rectangular duct take-offs and conical or bell mouth taps for round duct take-offs. Straight 90° taps are not allowed, except where round take-off duct size equals round branch duct size. Provide volume dampers at take- offs for balancing if not specifically noted as provided at outlet or inlet. Provide insulation guards at transitions to lined ductwork

4.20.3. Rectangular ductwork

All ductwork must comply with all local, code requirements. Ductwork shall be constructed of galvanized steel. Diagonally cross break all panels on ducts 750mm wide and larger, or bead using automatic bead machine with beads at 300mm on centre or less. All connections shall utilize 45° boot take-offs. Bullhead tees and straight taps are not permitted.

4.20.4. Round ductwork

Spiral lock seams, only. Lap or snap lock seams are not permitted for round ductwork of any size. Provide beaded sleeve joints or flanges with gasket joints. All elbows shall be long radius type with centreline radius to duct diameter of 1.5, exceptions will only be allowed at restricted space locations. All connections shall utilize welded conical tees. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted. Flat oval shall be utilized in space- restricted areas.

4.20.5. Flexible ductwork

Flexible round ductwork insulated with 25mm thick insulation may be utilized where shown on the Drawings and at the last 1.5m to each air outlet and inlet, unless shown otherwise on the plans. Maximum of only one 90° bend in any length. No intermediate joints are allowed. Connect each end with plastic draw bands. Support duct to maintain smooth shape without sagging. All connections shall utilize welded conical tees, aluminium conical fitting with damper or 45° boot take-offs. Spin-in type or other types of butt tees, bullhead tees or straight taps are not permitted.

Flexible ductwork for low pressure systems with positive static pressure at or below 500Pa positive pressure shall be a trilaminate of aluminized foil, fiberglass insulation, and aluminized polyester, mechanically locked to galvanized steel helix without adhesives, exterior 1” fiberglass insulation and fire-retardant plastic outer jacket.

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4.20.6. Plenums and equipment casings

Construct casings and plenums in conformance with the pressure and leakage classification of the ducting system.

Minimum Pressure Class: Unless otherwise indicated construct plenums and casings to withstand either a negative or positive static pressure of 1.000 Pa.

Single-Wall: Provide single-wall, casings and plenums where indicated on the drawings.

Use steel-angle-reinforced standing-seam construction.

Construct for static pressure indicated or for the maximum fan static pressure whichever is less.

4.20.7. Ductwork specialties

General: where specifically called for, materials for use in fabricating ductwork specialties shall be identical to that used to fabricate ductwork.

Ducts through roof shall be minimum 1.6 mm flashed and counter flashed and provided with storm collars to secure a watertight construction.

Bird Screens: ½", galvanized wire mesh, set in a galvanized steel frame, screw set.

4.20.8. Duct Insulation

Ducts shall be externally insulated with fire resistant (FM Global approved) Dust & Fibre free Armaflex/Climacover (Contractor to submit for approval by engineer) insulation of thickness as per spec sheet including vapour barrier. Insulation shall be self-adhered to the duct surface or by means of supplier approved adhesive contact. All protrusions and cuts through the insulation shall be sealed for the full insulation thickness. Joints in the insulation shall be taped by means of an approved tape type of the same quality as the vapour barrier and with a minimum overlap 50 mm. No vapour seal shall be left punctured.

Ducting exposed to the weather elements shall in addition to the Armaflex Insulation be cladded externally and labelled as per the insulation specification sheet.

All supply air components such as air terminals, duct accessories, flex ducts and plenum boxes internal to the admin building, shall be thermally insulated to match the duct insulation thickness.

Duct hangers shall not be covered with insulation. Hangers shall be removed one by one when applying external insulation. Insulating material shall be fixed to the duct with adhesive and strapped or clamped at intervals not exceeding 300 mm. Mechanical fastener pins may also be used on duct. Mechanical fasteners shall not penetrate the duct. The Contractor shall reinstate the integrity of the vapour barrier after the pins have been fixed.

All insulation material shall be compliant with Italian Regulations.

4.21. DAMPERS

4.21.1. Balancing dampers

Volume control dampers shall be installed in accessible locations at all branch connections and wherever necessary to adjust the flow of air to secure correct distribution. Casing and blades shall be made of galvanised sheet metal and shall be equipped with an approved device for fastening in

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any desired position. This device shall be such that the damper cannot move, or rattle and a pointer shall indicate the position of the damper from the outside of the finished duct insulation.

Dampers shall be of the aerofoil multi leaf opposed blade type with a blade height not more than 180 mm.

All blades shall be operated by a single operating quadrant with gears and links as necessary.

Spindles shall be non-corrodible, passing through bearings made of special plastic temperature resistant to 100 deg. C. Capped bearings shall be provided on the non-drive side.

The whole damper assembly shall be mounted in a galvanized frame with flanges.

4.21.2. Control dampers

Shut off and control dampers shall be installed as required for the proper functioning of the system under normal operation and according to the diagrams, layouts and this document.

- All rectangular control dampers shall be opposed blade
- Low leakage dampers
- Casing shall be galvanized sheet steel
- Blades shall be of natural anodized extruded aluminum
- Blade tip seals shall be silicon rubber
- Side seals shall be stainless steel
- External blade linkage shall be stainless steel
- Blade spindles shall be in stainless steel supported in plain brass bearings
- Shut off dampers shall have perforated blades to allow for minimum room ventilation when blades are in closed position
- The actuator shall be fixed in the factory and certified for proper operation

4.21.3. Backdraft dampers

Damper Types:

- Heavy Duty Backdraft Dampers: Provide counterweight type complete with frame, end bearings, counterbalance assembly, blades, and linkage. Pressure drop to be no more than 50 Pa at 5 m/s. Install at outside air intakes, exhaust outlets, and where shown on Drawings.

Manufacturer: see spec sheet

Application Requirements:

- Outside Air Intakes except where a control damper is required – Heavy Duty Backdraft Damper
- Exhaust openings except where a control damper is required – Heavy Duty Backdraft Damper

4.21.4. Fire and smoke dampers

The duct sections around fire dampers shall be enlarged to allow 100% unrestricted duct area while in the open position.

Approved type access doors, with airtight gaskets, shall be provided for the inspection and servicing of fire dampers.

All fire dampers shall have open/closed monitoring contacts.

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Provide fire dampers in all ducts in area, in the following locations, whether specifically or required by ordinances and codes:

- Duct entering and leaving fire shafts (duct shafts)
- Ducts passing through designated fire walls
- Ducts through floors, and not encased in fire shaft

Where fire dampers are located remote from the partition, the duct between the fire damper and the partition shall be encased in certified fireproofing acceptable to the local authorities having jurisdiction. In addition, all supports to fire-rated ductwork shall be up rated for the additional loading imposed by the fire rated insulation and to achieve the required structural integrity period.

All fire dampers except for the dampers related to transformer cooling shall be motorized. The fire valves shall be controlled by the fire alarm panel.

All fire dampers shall be of low noise and low resistance.

General:

- Provide a certified tested 2 hour rated fire dampers at 1.5-hour and greater penetrations
- Provide a certified and tested 1 hour rated fire dampers at less than 1-hour penetrations
- All dampers to be certified under the latest local Standard and requirements. Certification based on former non-current standards is unacceptable
- All damper installations to conform with fire regulation and manufacturer's installation instructions. Details on plans are shown for reference only
- Install in ducts passing through walls, floors, and ceilings as required by code. Refer to Architectural and Mechanical plans for damper locations
- Provide fire and fire/smoke dampers in locations as required by code
- Provide sleeves, slip joints, retaining angles, duct access doors, ceiling access panels, etc., as required to check and service the fire dampers. Slip or break away joints are not allowed to be taped or sealed. Access doors shall be tight fitting hinged or sliding and shall have 1" high label reading "FIRE DAMPER” or “FIRE/SMOKE DAMPER”
- All dampers to be designed for use in dynamic systems
- Dampers shall be rated for Leakage Class I. Leakage Class II may be used if damper size is smaller than available Leakage Class I dampers
- Dampers shall be certified for use by local authorities
- Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error. Do not install actuators in area where moisture can penetrate actuator or where temperature exceeds 50 °C
- All fire dampers shall be sized to provide equivalent free area through the damper equal to the connecting ductwork, or larger. Upsize fire damper as required. In no case is the damper pressure drops to exceed 60 Pa, but ideally less than 25 Pa, as designed for in total system static pressure allowance.

Combination Fire/Smoke Dampers:

- General Requirements:
    - Install at rated corridor wall or ceiling penetrations, occupancy separation walls, area separation walls and where shown on plans. Low leakage fire/smoke damper (Leakage Class 1 unless otherwise stated below) with electric actuator. Actuator shall be attached to sleeve outside of air stream. Fire/Smoke damper shall be equipped for vertical wall penetrations with manufacturer supplied sleeve and fail closed on loss of power. Each damper shall be equipped with a controlled 15 second electric heat-actuated release device. This device is to be equipped with a push-button reset. No manual fusible links are permitted. Manufacturer shall provide factory assembled

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sleeve of 16" minimum length. Installation shall be in accordance with damper manufacturer's instructions. Coordinate power and smoke detector connections with electrical installer. Integral smoke detection and actuating devices may be used if listed and approved for such service. Comply with building code requirements. All combination smoke and fire dampers shall automatically reset from closed to open position upon the reapplication of power to actuators

- Actuators: All gear and housing shall be steel. The actuator shall be direct coupled and employ a steel toothed cold-weld clamp for connecting to damper shafts. Aluminum clamps or set-screw attachments are not acceptable. Actuator shall be certified and manufactured under ISO 9001 quality control
    - Actuator shall carry a manufacturer's 5-year warranty
    - Actuator shall have microprocessor-based motor controller providing electronic cut off at full open so that no noise can be generated while holding open. Holding noise level shall be inaudible. Actuator shall be incapable of burning out if stalled before full rotation is reached
    - Dampers shall be installed straight and true, level in all planes, and square in all dimensions. Dampers shall move freely without undue stress due to twisting, racking, bowing, or other installation error
    - Actuator shall draw no more than 0.23A at 120V running, or 0.1A holding at 120V (27 VA and 10 VA respectively for 24V power) for 70 in-lb torque
    - Stall and instantaneous type actuators are not acceptable
    - Do not install in area where moisture can penetrate damper or actuator nor where actuator temperature exceeds 50 °C
    - All smoke and combination fire and smoke dampers shall be provided with Belimo Air controls FSNF120 (-S), FSNF24 (-S) actuators, or approved equal
    - If a Honeywell ML-4115 actuator is submitted as an alternate, it must be provided with a time delay relay to cause the actuator to reset to drive open mode on momentary loss of power for less than 3 seconds

Required Options:

- Provide open or closed indicator option assembly consisting of a single pole and a double throw switch used to indicate damper blade position. Output from switch to position indicator light (LED) is by automatic temperature control contractor. Include switch mounting bracket, crank arm, blade bracket and linkage from blade to the switch
- Provide a test module to permit test cycling of the damper/actuator in the field
- Provide integral smoke detector OR for overflow dampers
- Provide and field install smoke detector. Electrical installer shall wire
- For exposed wall applications provide matching wall grille to maintain appearance and fire

4.22. GRILLS AND LOUVERS

4.22.1. Louvers

Louvers are generally to be specified in the Arch. Where louvers are not covered on architectural plans and specifications, contractor is to provide under the following specification:

- Louvers to be 35° drainable fixed blade design, constructed of galvanized steel or extruded aluminium, or as specified on the plans
- Provide with ½" x ½" galvanized mesh bird screen mounted on backside of louver
- Finish/color per architect/engineer's review
- Manufacturer: per spec sheet

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4.22.2. Diffusers, grilles and registers

Diffusers shall be arranged for flush mounting in lay-in type ceilings and overlap mounting in plaster, mineral tile and similar ceilings.

All diffusers, grilles and louvres shall be supplied complete with factory powder coated finish. The finish colour shall be to the approval of the Architect. The interior of all grilles and diffusers is to be factory painted matt black.

All grilles and diffusers shall have a foam rubber sealing band around the edge to seal to the structure. Grilles and diffuser materials shall be aluminium extruded sections, unless otherwise specified. Sections in the airstream shall be carefully selected to minimize turbulence.

Grilles shall be complete with opposed blade dampers painted matt black and shall be fixed with universal mounting brackets. Both the damper and the fixing brackets shall be accessible through the face of the grille.

Ceiling Diffusers shall be multi-cone giving 4-way horizontal discharge.

The diffuser shall be complete with an opposed blade damper painted matt black.

Supply grilles/diffusers installed shall be located to ensure adequate ventilation of the rooms and shall not allow stagnant pockets of air to form. Face velocities shall be chosen to give adequate throw whilst preventing draughts within the room.

All diffusers, grilles, and registers shall be selected to provide proper air distribution for the intended occupant application. All supply air devices shall be selected to provide a maximum air velocity of 0.25m/s at three feet above the floor, unless otherwise noted. Manufacturer's representative shall carefully review Architectural and Mechanical drawings and ensure diffuser/grille/register selections will provide proper air distribution at NC 25 or less. Manufacturer at no additional expense to the Owner shall replace diffusers, grilles, and registers not providing proper distribution or excessive noise at scheduled airflow.

All frames shall be selected to fit the ceiling type. Verify with Architectural Drawing. Each diffuser, grille and register shall be individually capable of balancing via duct mounted balancing dampers or attached opposed blade dampers. Provide unit opposed blade damper where individual duct mounted balancing dampers are not provided.

4.22.3. Linear slot diffusers

Linear diffusers with supply or return slots, with adjustable anodized aluminum profile deflectors with a high induction ratio (mixing capacity) between the supplied air and the ambient air. Made of anodized extruded aluminum profiles coupled to obtain multiple slots inside which adjustable aluminum deflectors are housed. The flow of the supplied air can be oriented in a right, left or alternate direction, by varying the position of the deflectors.

The air flow can be adjusted by means of a calibration damper on the terminal, which can be operated from the outside with the diffuser installed without any disassembly.

The diffuser will be equipped with a conveying plenum with upper or lateral connections depending on the installation; the quantity and section of the connections will depend on the flow rate and size of the individual diffuser.

Construction in anodized aluminum or white painted aluminum RAL 9010 or another color chosen by the DL.

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4.22.4. Supply grilles

Supply grilles with double series of adjustable fins; it must be supplied complete with a calibration damper of the type with opposing fins with adjustment that can be performed from the outside of the vent, a counter frame for fixing to the duct or for any masonry and possibly a plenum. The grille will be made of extruded aluminum, anodized in natural color or painted with a color chosen by the DL, while the calibration damper and the counter frame will be made of galvanized steel sheet. The grille will be fixed to the counter frame using clips or self-tapping chrome screws that are not visible; during assembly, it will be sufficient to drill holes in the counter frame corresponding to the holes provided on the grille frame, screw the grille and seal the perimeter (in the case of applications outside the building). The grilles may be square, rectangular or circular in shape depending on what is indicated in the design documents; the dimensions of the hole to be provided correspond to the nominal dimensions of the grille.

4.22.5. Return grilles

Air intake grille with a single series of fixed fins; it must be supplied complete with a calibration damper of the type with opposing fins with adjustment that can be performed from the outside of the vent, a counter frame for fixing to the duct or for any masonry and possibly a plenum. The grille will be made of extruded aluminum, anodized in natural color or painted with a color chosen by the DL, while the calibration damper and the counter frame will be made of galvanized steel sheet. The grille will be fixed to the counter frame using clips or self-tapping chrome screws that are not visible; during assembly, it will be sufficient to drill holes in the counter frame corresponding to the holes provided on the grille frame, screw the grille and seal the perimeter (in the case of applications outside the building). The grilles may be square, rectangular or circular in shape depending on what is indicated in the design documents; the dimensions of the hole to be provided correspond to the nominal dimensions of the grille. Where provided, as per design specifications, the grills will be equipped with an openable filter holder (push-open) complete with built-in frame and filter cell. Frame and grill can be separated for ease of installation.

4.22.6. External grilles for air intake and exhaust air

Made of a sturdy structure in natural anodized extruded aluminum, composed of a frame, a row of fixed horizontal fins inclined downwards, with a special anti-rain profile and pitch of the fins is 30/50/100 mm, depending on the front section and, where required by a plenum; the union between fins and frame will be made with a mechanical system.

Installation by means of visible screws on the frame, through pre-arranged holes; complete with walled-in counterframe and insect net.

4.22.7. Suction valves

The suction valves for the extraction of toilets must be made of a front part in sheet steel, electrostatic epoxy paint (similar to RAL 9010, thickness 60 µm), threaded rod and nut in galvanized steel, mounting subframe in galvanized sheet steel. The ventilation valves must also be equipped with a central disk and a collar, with a gasket on the perimeter edge that guarantees perfect positioning of the valve in its seat. The flow rate must be adjusted by rotating the central disk.

The sizing was done by imposing that the load losses, in the central position of the adjustable element, do not exceed 50 Pa.

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4.23. DUCT SMOKE DETECTORS (DSD)

Duct mounted photoelectric smoke detector. One required for each heating or cooling system supplying air in excess of 3.000 m3/h, for systems serving more than one occupancy type, and for control of each combination fire/smoke damper when not controlled by wide detection system. Coordinate with electrical installer for power to smoke detector. Detector shall be mounted in the supply air ductwork downstream of the air handler and filters, an at the air intake. Coordinate with control installer to assure that detector shall shut down the air-moving equipment when smoke is detected and closely associated damper actuator(s). Sensor shall be selected to operate with air velocity rating from 0.5 to 20 m/s. Provide with metal sampling tube. Provide remote test and reset station at ceiling or as otherwise indicated. Duct smoke detector shall be installed in compliance with the applicable mechanical or building code.

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5. VENDOR LIST MAIN EQUIPMENTS

CRAHs:

- Vertiv
- Stultz
- Mitsubishi

AHUs:

- Roccheggiani
- Euroclima
- SAMP

Pressurization/Degassing units:

- IMI
- Flamco

Side stream filters:

- FAM Group

DX systems:

- Daikin
- Mitsubishi

VRF systems:

- Daikin
- Mitsubishi

TES tanks:

- Fiorini
- Sile

PICV valves:

- IMI
- Danfoss
- Bray

Water leak detection:

- TTK (Temar)

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Glycol leak detection:

- GUS (Temar)
- AuRü

Vacuum fuel leak detection:

- Greenline

Fuel cabinet and fuel monitoring:

- Greenline

Fuel underground tanks:

- DEMO
- Righetto

Smoke extraction fans:

- Systemair
- TROX

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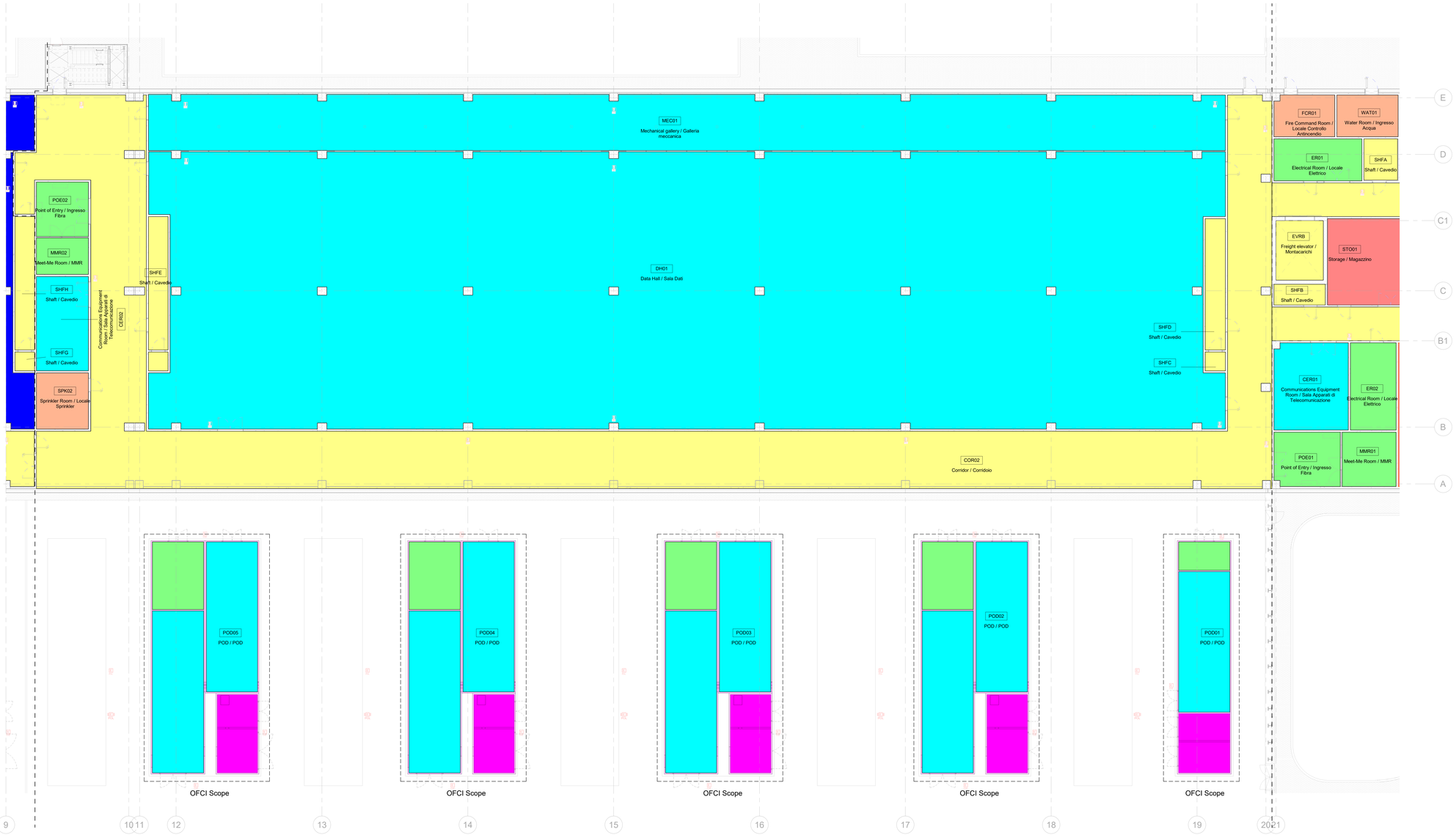

Legend HVAC Zoning

- Chilled Water Critical Cooling phase 1 + Critical Ventilation
- Chilled Water Critical Cooling phase 2 + Critical Ventilation
- DX Critical Cooling phase 1 + Critical Ventilation
- DX Critical Cooling phase 2 + Critical Ventilation
- DX Non-Critical Cooling phase 1 + Non-Critical Ventilation
- DX Non-Critical Cooling phase 2 + Non-Critical Ventilation
- Non Critical VRF Heating/Cooling + Non-Critical Ventilation
- Technical Rooms Electrical Heating 10 °C + Non-Critical Ventilation
- Changing Rooms Electrical Heating 20 °C + Non-Critical Ventilation
- Unheated + Air extraction for bathrooms
- Transformer Rooms Ventilation phase 1
- Transformer Rooms Ventilation phase 2

Heating/Cooling Table

Room	System	Redundancy	Terminal Units	Indoor Design Condition	
				Winter	Summer
Data hall	Critical Cooling	N+2 (air cooling)	Fan Wall (air cooling)	27 °C (20/80 %)	27 °C (20/80 %)
CER	Critical Cooling	N+1	CRAH	27 °C	27 °C
LV POD	Critical Cooling	N+1	CRAH	27 °C	27 °C
BAT	Critical Cooling	N+1	DX units	25 °C	25 °C
MMR, Electrical corridor	Critical Cooling	N+1	DX units	25 °C	25 °C
MV POD	Critical Cooling	-	Fans	max 40 °C	max 40 °C
Office, Break Room, Conference Room	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Bathroom, Corridor, Staircase	-	-	-	-	-
Storage, Staging, Loading	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Changing Room	-	-	-	20 °C	-
Technical Room	Non Critical Heating	-	Electrical heaters	10 °C	-

Ventilation Table 1 (basic of design)

Room	System	Redundancy	Relative Pressure	Recirculated Supply Air
Data hall	Critical Ventilation	N+1 (for pressurization and humidity control)	Positive	Yes
MMR, CER	Critical or Non Critical Ventilation	-	Positive	Yes
POD	Independent Ventilation (OFCI)	-	Positive	Yes
BAT	Battery Extraction System	N+1	Negative	No
Office, Break Room, Conference Room	Non Critical Ventilation	-	-	Yes
Bathroom	Bathroom Extraction System	-	Negative	No
Changing Room	Non Critical Ventilation	-	-	Yes
Storage, Staging, Loading	Non Critical Ventilation	-	-	Yes
Corridor, Staircase	-	-	-	-
Technical Room	Non Critical Ventilation	-	Positive	Yes

Ventilation Table 2 (ventilation design rates)

Room	Occupancy (m2/person)	L/s per person	L/s*mq	Air Change per Hour
Data hall	0,04	2,5	0,3	-
MMR, CER	-	-	-	0,5
POD	-	-	-	TBD by OFCI vendor
BAT*	-	-	-	-
Office	0,05 (or number of seats)	2,5	0,3	-
Conference Room	0,5 (or number of seats)	2,5	0,3	-
Lobby	0,1	2,5	0,3	-
Break Room	0,5	2,5	0,6	-
Janitorial	-	-	5	-
Changing Room	-	-	2,5	-
Bathroom	-	-	12,5 (per each WC)	-
Storage	-	-	-	0,5
Staging, Loading	0,02	5	0,6	-
Corridor, Staircase	-	-	-	-
Technical Room	-	-	-	0,5

*Ventilation rates for batteries calculated according to CEI EN IEC 62485-2 or according to relevant code depending on the type and quantity of batteries installed. In case of lithium batteries an emergency extraction system is required to prevent hazard atmosphere, according to NFPA69 (5,1 l/s/m2). System TBD by OFCI vendor.

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Progetto Nome Progetto
STACK MIL07 Datacenter

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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A1	00	DR	M	50	002

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

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P01	S4 - IMAA3 Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Zonizzazione Impianti Meccanici
Piano Terra (00) Fase 1 Critica

Subject:
Mechanical
Layout - HVAC Zoning
Ground Floor (00) Critical phs.1

SIZE / FORMATO: A0 ×1 (841*1189)
SCALE / SCALA: As indicated
DRAWN BY / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Buselli

FILE NAME / NOME FILE: MIL07-DBA-A1-00-DR-M-50002.P01

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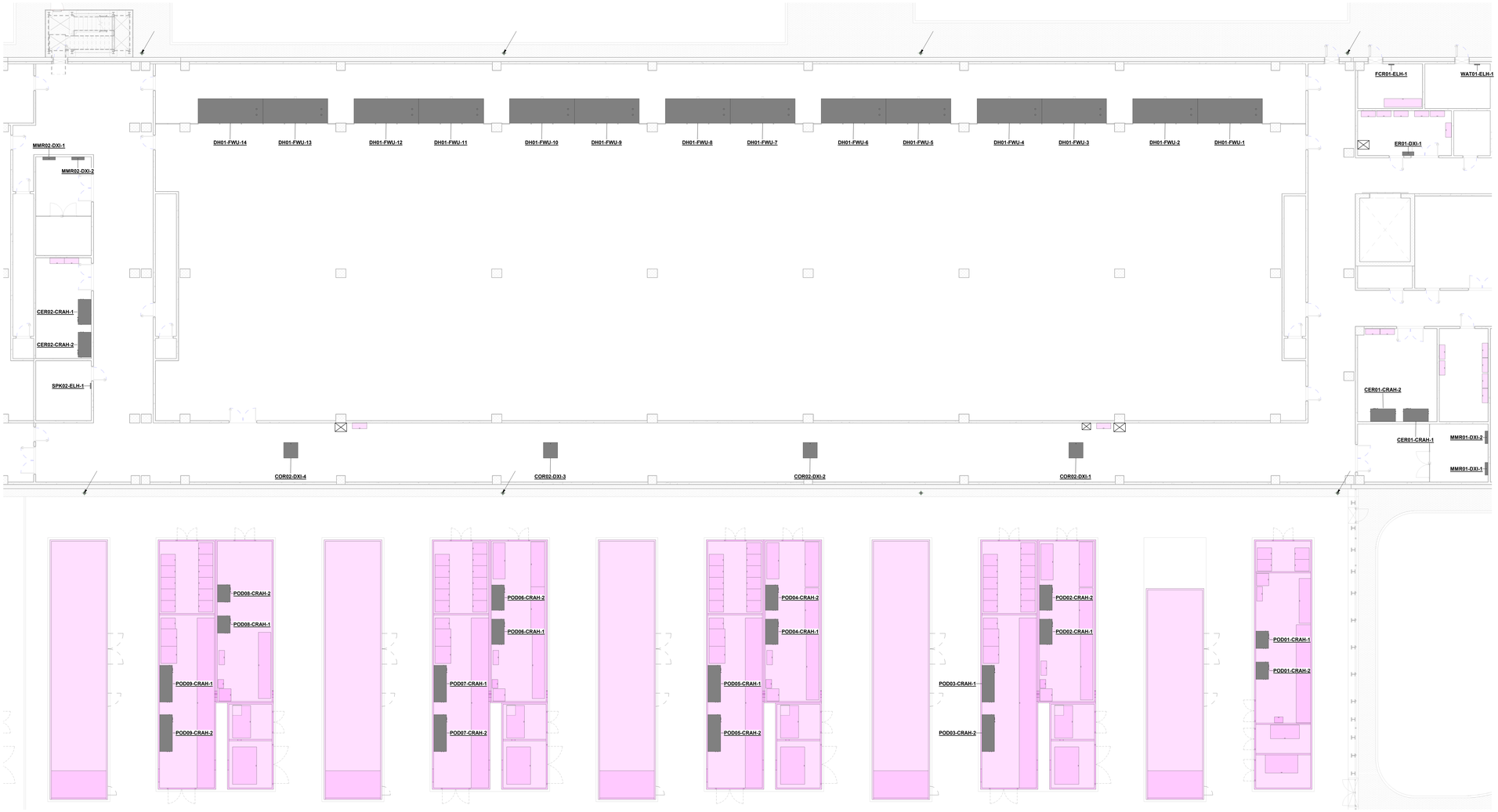

0 2 4 6 8 10m

Fan Walls

Location	Liquid	Water temperatures	Air temperatures	Cooling capacity	Electrical consumption	Number of equipment inside the room	Redundancy	Air cooling load inside the room
DM	Water	23 / 33°C	27 / 37.8°C	540 kW	38 kW	14	N+2	6,12 MW

CRAHs

H1 POD 1R LV2 POD	Water	23 / 33°C	27 / 37°C	25 kW	1 kW	2	N+1	25 kW
1A/1B/1C/1R 2A/2B/2C LV1 POD	Water	23 / 33°C	27 / 37°C	105 kW	7,53 kW	2	N+1	105 kW
1A/1B/1C 2A/2B/2C LV2 POD	Water	23 / 33°C	27 / 37°C	50 kW	2,1 kW	2	N+1	50 kW
CER	Water	23 / 33°C	27 / 37°C	40 kW	1,4 kW	2	N+1	40 kW

Cooling thermal storage system

Type	Liquid	Liquid temperatures	Break time	Size	Tanks number for riser	Riser redundancy	Total system capacity
Squared outdoor pressurized tanks	Water	23 / 33°C	300 sec	35 mc	2	N+1 (2+1)	210 mc

Chiller

Unit type	Liquid	Liquid temperatures	Ambient design conditions	Cooling capacity	Electrical consumption	Total chiller number	Redundancy	Total cooling capacity
Air to water chillers with free-cooling kit	Water	23 / 33°C	43°C	1220 kW	320 kW + 30 kw of pump	14	N+2	14,64 MW

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STACK MIL07 Datacenter

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P01	S4 - RIBAS Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Posizionamento Attrezzature Meccaniche
Piano Terra (00) Fase 1 Critica

Subject:
Mechanical
Layout - Main Mechanical Equipments
Ground Floor (00) Critical phs.1

SIZE / FORMATO: A0 +1 (841*1189)
DRAW SCALE: As indicated
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A1-00-DR-M-50101.P01

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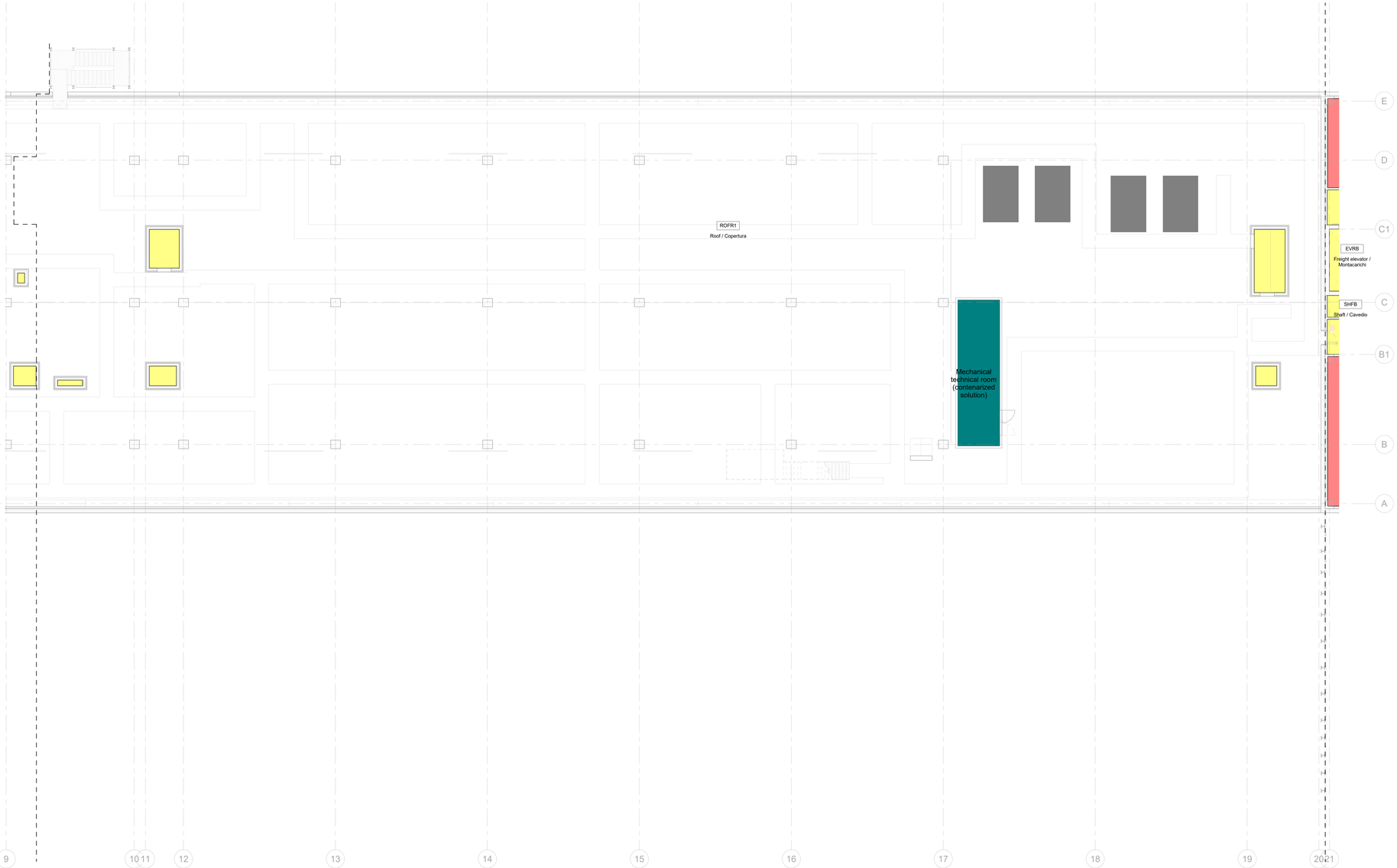

Legend HVAC Zoning

- Chilled Water Critical Cooling phase 1 + Critical Ventilation
- Chilled Water Critical Cooling phase 2 + Critical Ventilation
- DX Critical Cooling phase 1 + Critical Ventilation
- DX Critical Cooling phase 2 + Critical Ventilation
- DX Non-Critical Cooling phase 1 + Non-Critical Ventilation
- DX Non-Critical Cooling phase 2 + Non-Critical Ventilation
- Non Critical VRF Heating/Cooling + Non-Critical Ventilation
- Technical Rooms Electrical Heating 10 °C + Non-Critical Ventilation
- Changing Rooms Electrical Heating 20 °C + Non-Critical Ventilation
- Unheated + Air extraction for bathrooms
- Transformer Rooms Ventilation phase 1
- Transformer Rooms Ventilation phase 2

Heating/Cooling Table

Room	System	Redundancy	Terminal Units	Indoor Design Condition	
				Winter	Summer
Data hall	Critical Cooling	N+2 (air cooling)	Fan Wall (air cooling)	27 °C (20/80 %)	27 °C (20/80 %)
CER	Critical Cooling	N+1	CRAH	27 °C	27 °C
LV POD	Critical Cooling	N+1	CRAH	27 °C	27 °C
BAT	Critical Cooling	N+1	DX units	25 °C	25 °C
MMR, Electrical corridor	Critical Cooling	N+1	DX units	25 °C	25 °C
MV POD	Critical Cooling	-	Fans	max 40 °C	max 40 °C
Office, Break Room, Conference Room	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Bathroom, Corridor, Staircase	-	-	-	-	-
Storage, Staging, Loading	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Changing Room	-	-	-	20 °C	-
Technical Room	Non Critical Heating	-	Electrical heaters	10 °C	-

Ventilation Table 1 (basic of design)

Room	System	Redundancy	Relative Pressure	Recirculated Supply Air
Data hall	Critical Ventilation	N+1 (for pressurization and humidity control)	Positive	Yes
MMR, CER	Critical or Non Critical Ventilation	-	Positive	Yes
POD	Independent Ventilation (OFCI)	-	Positive	Yes
BAT	Battery Extraction System	N+1	Negative	No
Office, Break Room, Conference Room	Non Critical Ventilation	-	-	Yes
Bathroom	Bathroom Extraction System	-	Negative	No
Changing Room	Non Critical Ventilation	-	-	Yes
Storage, Staging, Loading	Non Critical Ventilation	-	-	Yes
Corridor, Staircase	-	-	-	-
Technical Room	Non Critical Ventilation	-	Positive	Yes

Ventilation Table 2 (ventilation design rates)

Room	Occupancy (m2/person)	L/s per person	L/s*mq	Air Change per Hour
Data hall	0,04	2,5	0,3	-
MMR, CER	-	-	-	0,5
POD	-	-	-	TBD by OFCI vendor
BAT*	-	-	-	-
Office	0,05 (or number of seats)	2,5	0,3	-
Conference Room	0,5 (or number of seats)	2,5	0,3	-
Lobby	0,1	2,5	0,3	-
Break Room	0,5	2,5	0,6	-
Janitorial	-	-	5	-
Changing Room	-	-	2,5	-
Bathroom	-	-	12,5 (per each WC)	-
Storage	-	-	-	0,5
Staging, Loading	0,02	5	0,6	-
Corridor, Staircase	-	-	-	-
Technical Room	-	-	-	0,5

* Ventilation rates for batteries calculated according to CEI EN IEC 62485-2 or according to relevant code depending on the type and quantity of batteries installed. In case of lithium batteries an emergency extraction system is required to prevent hazard atmosphere, according to NFPA69 (5,1 l/s/m2). System TBD by OFCI vendor.

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente:
ARC:BIM
2nd Floor, 140 St John Street - London, GB

ARC:BIM

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Sede secondaria:
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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A1	R1	DR	M	50	021

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038/001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - IMMAG Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Zonizzazione Impianti Meccanici
Copertura (R1) Fase 1 Critica
Subject:
Mechanical
Layout - HVAC Zoning
Roof (R1) Critical phs.1

A0 n°1 (841*1189)
SCALE / SCALA: As indicated
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A1-R1-DR-M-5002-P01

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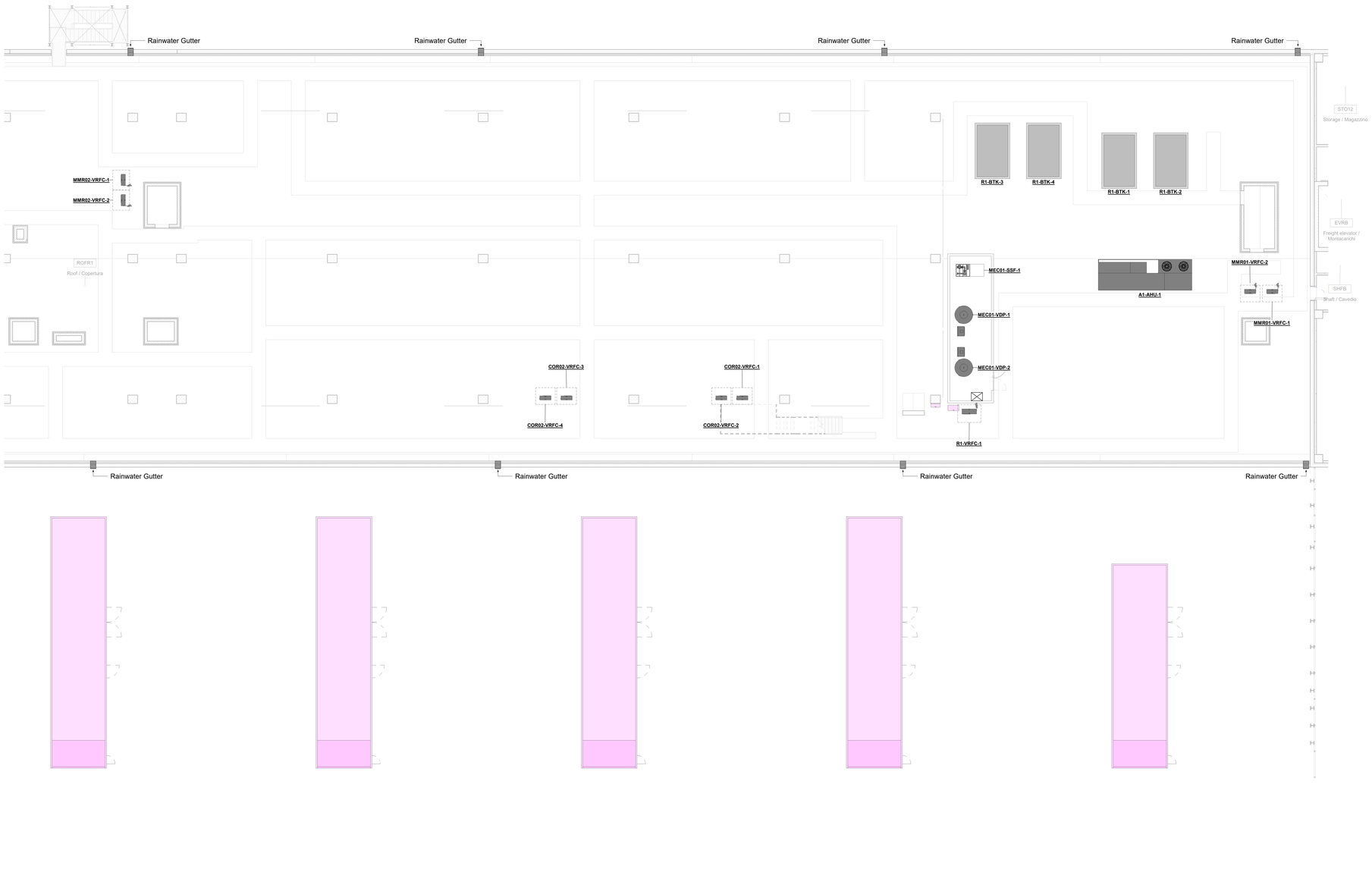

0 2 4 6 8 10m

Fan Walls

Location	Liquid	Water temperatures	Air temperatures	Cooling capacity	Electrical consumption	Number of equipment inside the room	Redundancy	Air cooling load inside the room
DM	Water	23 / 33°C	27 / 37.8°C	540 kW	38 kW	14	N+2	6,12 MW

CRAHs

H1 POD 1R LV2 POD	Water	23 / 33°C	27 / 37°C	25 kW	1 kW	2	N+1	25 kW
1A/1B/1C/1R 2A/2B/2C LV1 POD	Water	23 / 33°C	27 / 37°C	105 kW	7,53 kW	2	N+1	105 kW
1A/1B/1C 2A/2B/2C LV2 POD	Water	23 / 33°C	27 / 37°C	50 kW	2,1 kW	2	N+1	50 kW
CER	Water	23 / 33°C	27 / 37°C	40 kW	1,4 kW	2	N+1	40 kW

Cooling thermal storage system

Type	Liquid	Liquid temperatures	Break time	Size	Tanks number for riser	Riser redundancy	Total system capacity
Squared outdoor pressurized tanks	Water	23 / 33°C	300 sec	35 mc	2	N+1 (2+1)	210 mc

Chiller

Unit type	Liquid	Liquid temperatures	Ambient design conditions	Cooling capacity	Electrical consumption	Total chiller number	Redundancy	Total cooling capacity
Air to water chillers with free-cooling kit	Water	23 / 33°C	43°C	1220 kW	320 kW + 30 kw of pump	14	N+2	14,64 MW

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente
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2nd Floor, 140 St John Street - London, GB

ARC:BIM

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fax. +39 0422 1644001

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL S.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A1	R1	DR	M	50	121

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - RIBA3 Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Posizionamento Attrezzature Meccaniche
Copertura (R1) Fase 1 Critica
Subject:
Mechanical
Layout - Main Mechanical Equipments
Roof (R1) Critical phs.1

SIZE / FORMATO: A0 +1 [841*1188]
SCALE / SCALA: As indicated
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A1-R1-DR-M-50121.P01

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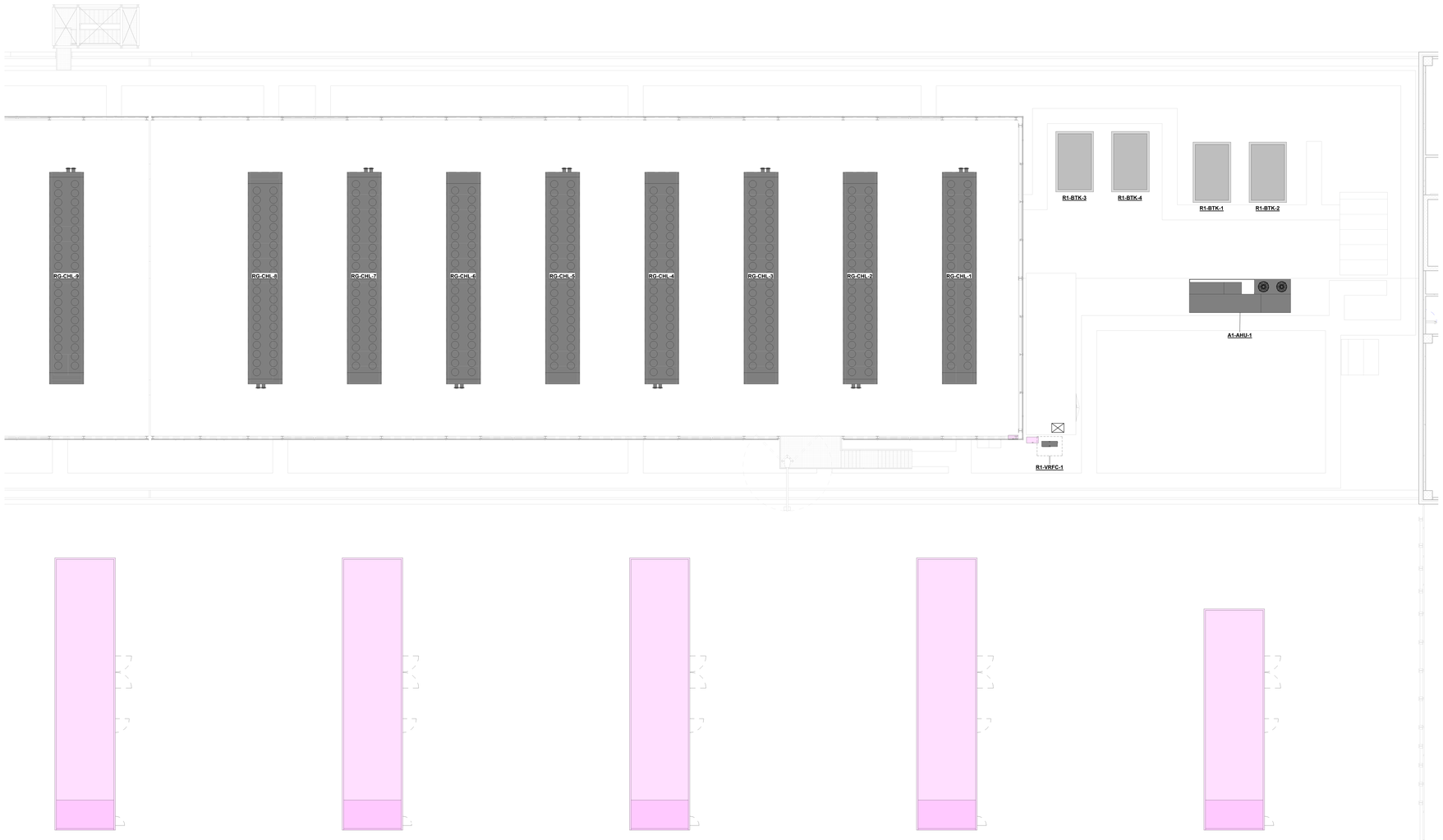

0 2 4 6 8 10m

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto
STACK MIL07 Datacenter

Location / Indirizzo progetto
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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A1	RG	DR	M	50	130

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - BIMAX Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Posizionamento Attrezzature Meccaniche
Piattaforma Chiller (RG) Fase 1 Critica
Subject:
Mechanical
Layout - Main Mechanical Equipments
Roof Gantry (RG) Critical phs.1

ISO - FORMAT: A0 +1 (841*1189)
SCALE / SCALA: As indicated
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A1-RG-DR-M-50130.P01

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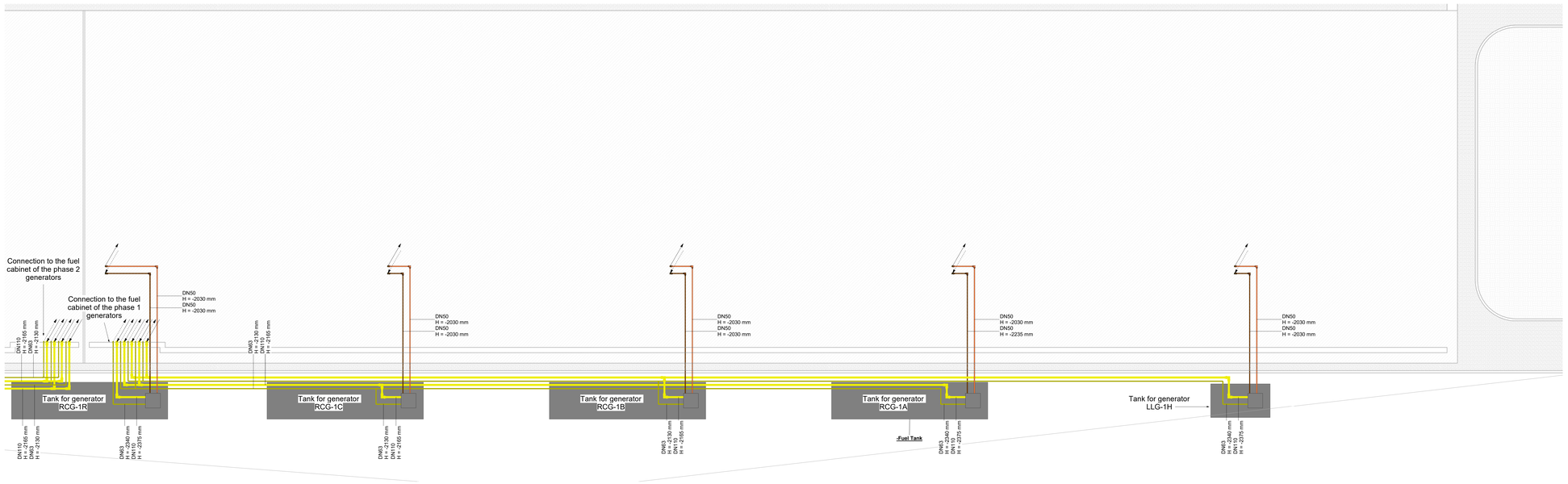
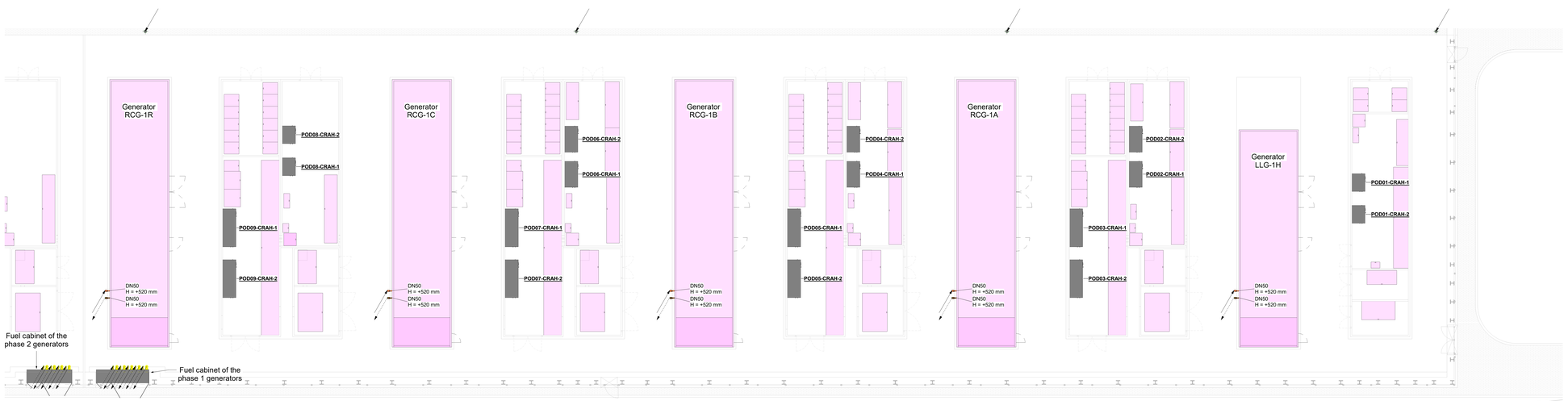


Fuel System Phase 1 - Underground Planview

1 : 100



Fuel System Phase 1 - Aboveground Planview

1 : 100

0 2 4 6 8 10m

Fuel system legend / Legenda impianto gasolio

- Diesel fuel tank supply pipe / Tubazione gasolio rifornimento serbatoio
- Diesel fuel loop-closure and ventilation pipe / Tubazione gasolio chiusura anello e ventilazione
- Generators / Gruppi elettrogeni

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
Hrxxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
Hrxxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Flow Direction Arrow / Frecce di Direzione del Flusso

Supply flow / Flusso di mandata

- Supply flow to above / Flusso di mandata verso l'alto
- Supply flow to below / Flusso di mandata verso il basso
- Supply flow from below to above / Flusso di mandata dal basso verso l'alto
- Supply flow from above to below / Flusso di mandata dall'alto verso il basso
- Refrigerant gas or liquid pipe flow / Flusso tubi con gas o liquido refrigerante

Return flow / Flusso di ripresa

- Return flow to above / Flusso di ripresa verso l'alto
- Return flow to below / Flusso di ripresa verso il basso
- Return flow from below to above / Flusso di ripresa dal basso verso l'alto
- Return flow from above to below / Flusso di ripresa dall'alto verso il basso

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

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BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodero*

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Sede secondaria: Viale Liguria, 24 31020 Villorba (TV) tel. +39 0422.693911
certificata **ISO 9001:2015** RINA n.5925/01/S Cgleo n.17-1546-B

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A1	ZZ	DR	M	54	500

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - BIM(i) Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Impianto Adduzione Gasolio
Piano Terra (00) e Interrato (UG) Fase 1 Critica

Subject:
Mechanical
Layout - Fuel
Ground Floor (00) and Undergound (UG) Critical phs.1

SIZE / FORMATO: A0 x1 (841*1189)
SCALE / SCALA: 1 : 100
DRAWN BY / DISEGNATO: M. Colombo
CHECKED BY / CONTROLLATO: G. Russo
APPROVED BY / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A1-ZZ-DR-M-5450.P01

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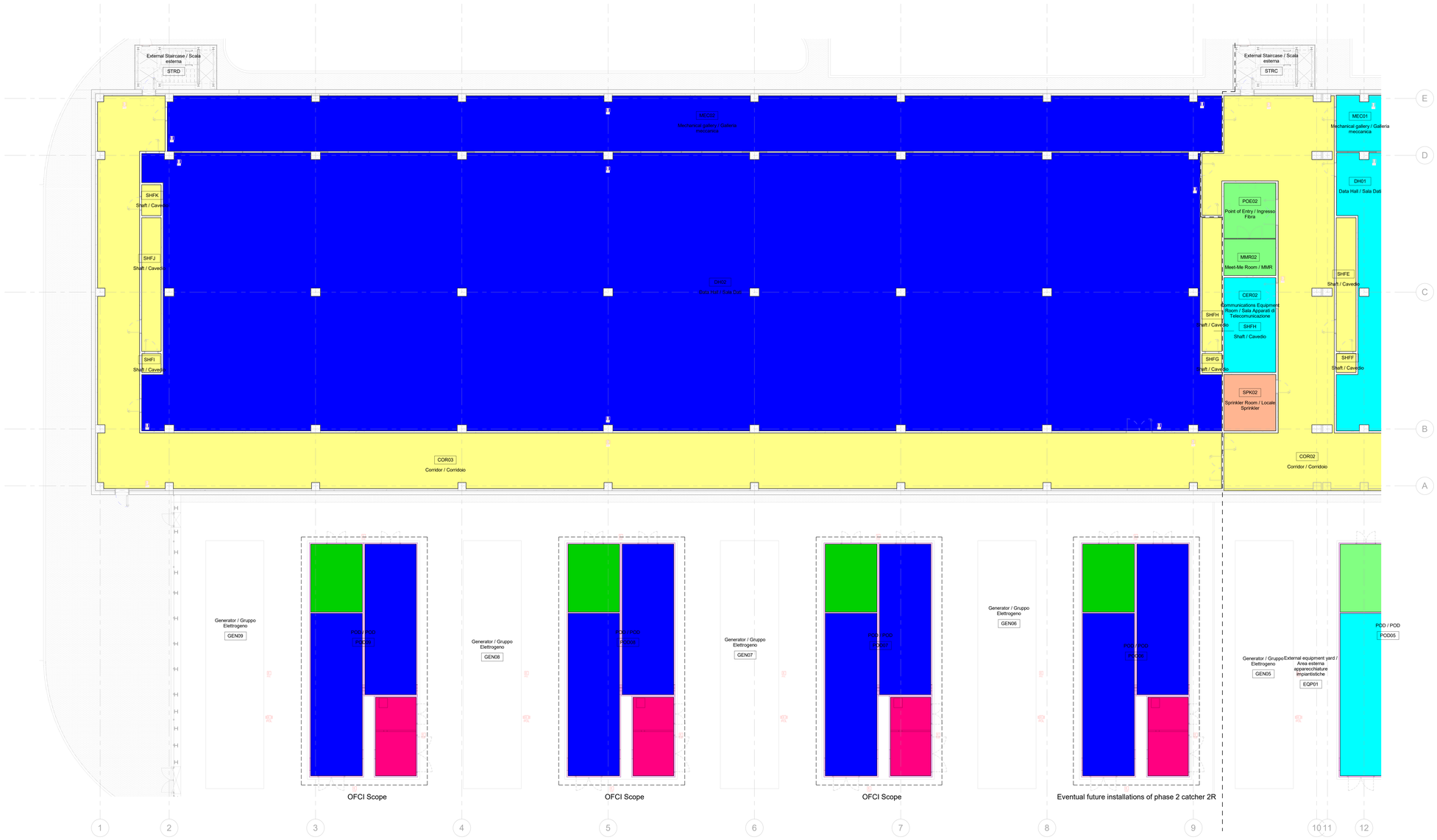

Legend HVAC Zoning

- Chilled Water Critical Cooling phase 1 + Critical Ventilation
- Chilled Water Critical Cooling phase 2 + Critical Ventilation
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- DX Critical Cooling phase 2 + Critical Ventilation
- DX Non-Critical Cooling phase 1 + Non-Critical Ventilation
- DX Non-Critical Cooling phase 2 + Non-Critical Ventilation
- Non Critical VRF Heating/Cooling + Non-Critical Ventilation
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Data hall	Critical Cooling	N+2 (air cooling)	Fan Wall (air cooling)	27 °C (20/80 %)	27 °C (20/80 %)
CER	Critical Cooling	N+1	CRAH	27 °C	27 °C
LV POD	Critical Cooling	N+1	CRAH	27 °C	27 °C
BAT	Critical Cooling	N+1	DX units	25 °C	25 °C
MMR, Electrical corridor	Critical Cooling	N+1	DX units	25 °C	25 °C
MV POD	Critical Cooling	-	Fans	max 40 °C	max 40 °C
Office, Break Room, Conference Room	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Bathroom, Corridor, Staircase	-	-	-	-	-
Storage, Staging, Loading	Non Critical Cooling/Heating	-	VRF units	20 °C (30/70 %)	26 °C (30/70 %)
Changing Room	-	-	-	20 °C	-
Technical Room	Non Critical Heating	-	Electrical heaters	10 °C	-

Ventilation Table 1 (basic of design)

Room	System	Redundancy	Relative Pressure	Recirculated Supply Air
Data hall	Critical Ventilation	N+1 (for pressurization and humidity control)	Positive	Yes
MMR, CER	Critical or Non Critical Ventilation	-	Positive	Yes
POD	Independent Ventilation (OFCI)	-	Positive	Yes
BAT	Battery Extraction System	N+1	Negative	No
Office, Break Room, Conference Room	Non Critical Ventilation	-	-	Yes
Bathroom	Bathroom Extraction System	-	Negative	No
Changing Room	Non Critical Ventilation	-	-	Yes
Storage, Staging, Loading	Non Critical Ventilation	-	-	Yes
Corridor, Staircase	-	-	-	-
Technical Room	Non Critical Ventilation	-	Positive	Yes

Ventilation Table 2 (ventilation design rates)

Room	Occupancy (m2/person)	L/s per person	L/s*mq	Air Change per Hour
Data hall	0,04	2,5	0,3	-
MMR, CER	-	-	-	0,5
POD	-	-	-	TBD by OFCI vendor
BAT*	-	-	-	-
Office	0,05 (or number of seats)	2,5	0,3	-
Conference Room	0,5 (or number of seats)	2,5	0,3	-
Lobby	0,1	2,5	0,3	-
Break Room	0,5	2,5	0,6	-
Janitorial	-	-	5	-
Changing Room	-	-	2,5	-
Bathroom	-	-	12,5 (per each WC)	-
Storage	-	-	-	0,5
Staging, Loading	0,02	5	0,6	-
Corridor, Staircase	-	-	-	-
Technical Room	-	-	-	0,5

*Ventilation rates for batteries calculated according to CEI EN IEC 62485-2 or according to relevant code depending on the type and quantity of batteries installed. In case of lithium batteries an emergency extraction system is required to prevent hazard atmosphere, according to NFPA69 (5,1 l/s/m2). System TBD by OFCI vendor.

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

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BIM Coordinator - *R. Sodano*

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Tel. +39 0438 1410 - 500
C.F. 04382160963 - C.C.I.A.A. n.1118616

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A2	00	DR	M	50	003

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION - DESCRIZIONE REVISIONE	REVISION DATE

BIM - DA - BIMAG Subsidiar | [01+02]BIS

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Zonizzazione Impianti Meccanici
Piano Terra (00) Fase 2 Critica

Subject:
Mechanical
Layout - HVAC Zoning
Ground Floor (00) Critical phs.2

SCE / FORMATO: A0 +1 [841*1189]
SCALE / SCALA: As indicated
DRAWN / REDATTO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A2-00-DR-M-50003-P01

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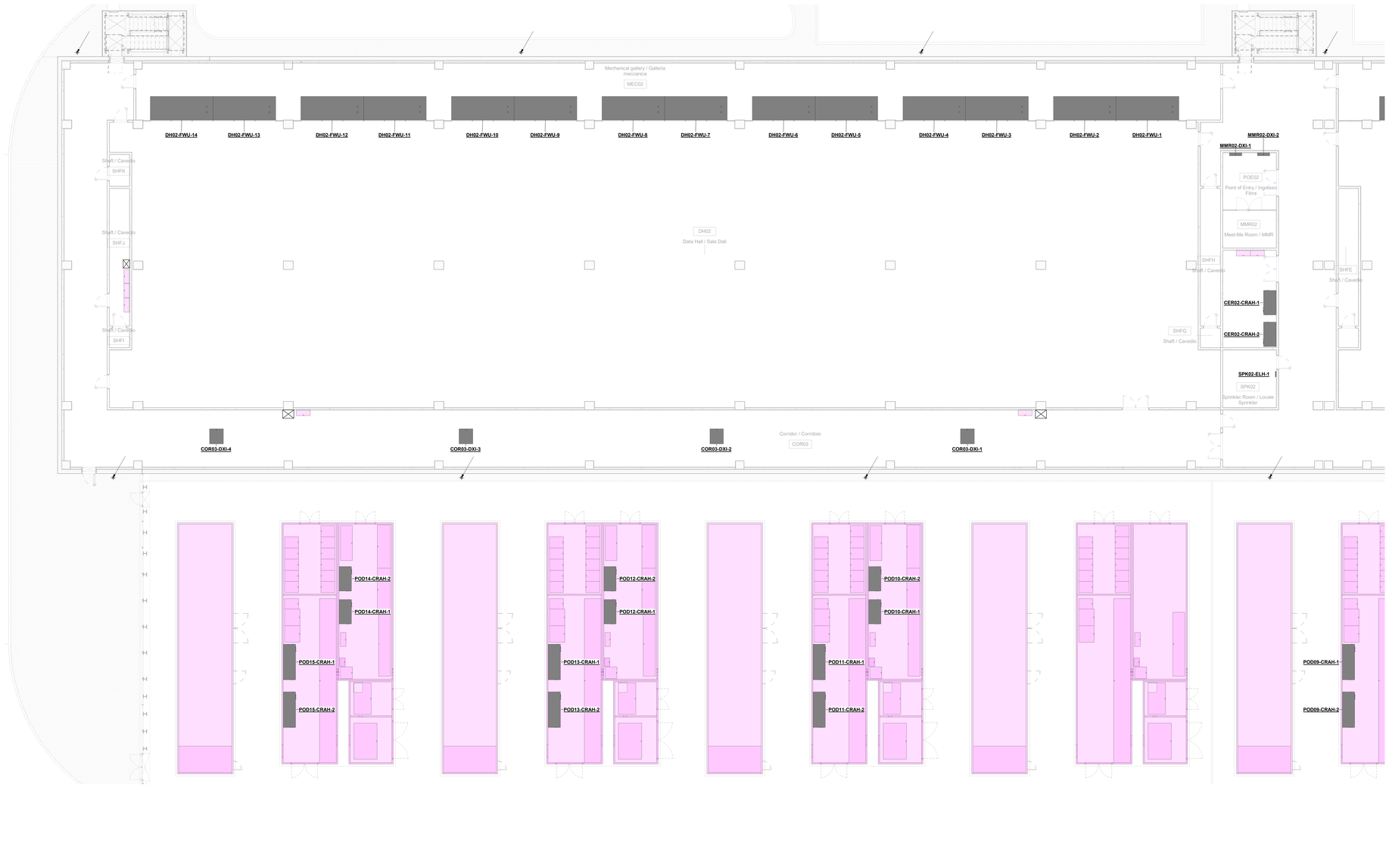

0 2 4 6 8 10m

Fan Walls

Location	Liquid	Water temperatures	Air temperatures	Cooling capacity	Electrical consumption	Number of equipment inside the room	Redundancy	Air cooling load inside the room
DM	Water	23 / 33°C	27 / 37.8°C	540 kW	38 kW	14	N+2	6,12 MW

CRAHs

H1 POD 1R LV2 POD	Water	23 / 33°C	27 / 37°C	25 kW	1 kW	2	N+1	25 kW
1A/1B/1C/1R 2A/2B/2C LV1 POD	Water	23 / 33°C	27 / 37°C	105 kW	7,53 kW	2	N+1	105 kW
1A/1B/1C 2A/2B/2C LV2 POD	Water	23 / 33°C	27 / 37°C	50 kW	2,1 kW	2	N+1	50 kW
CER	Water	23 / 33°C	27 / 37°C	40 kW	1,4 kW	2	N+1	40 kW

Cooling thermal storage system

Type	Liquid	Liquid temperatures	Break time	Size	Tanks number for riser	Riser redundancy	Total system capacity
Squared outdoor pressurized tanks	Water	23 / 33°C	300 sec	35 mc	2	N+1 (2+1)	210 mc

Chiller

Unit type	Liquid	Liquid temperatures	Ambient design conditions	Cooling capacity	Electrical consumption	Total chiller number	Redundancy	Total cooling capacity
Air to water chillers with free-cooling kit	Water	23 / 33°C	43°C	1220 kW	320 kW + 30 kw of pump	14	N+2	14,64 MW

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente:
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BIM Coordinator - *R. Sodero*

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P.IVA IT01070250257
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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A2	00	DR	M	50	102

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13030001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - IfBAG Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Posizionamento Attrezzature Meccaniche
Piano Terra (00) Fase 2 Critica
Subject:
Mechanical
Layout - Main Mechanical Equipments
Ground Floor (00) Critical pha 2

SIZE / FORMATO: A0 +1 (841*1189)
SCALE / SCALA: As indicated
DRAWN / REDATTO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Buselli

FILE NAME / NOME FILE: MIL07-DBA-A2-00-DR-M-50102.P01

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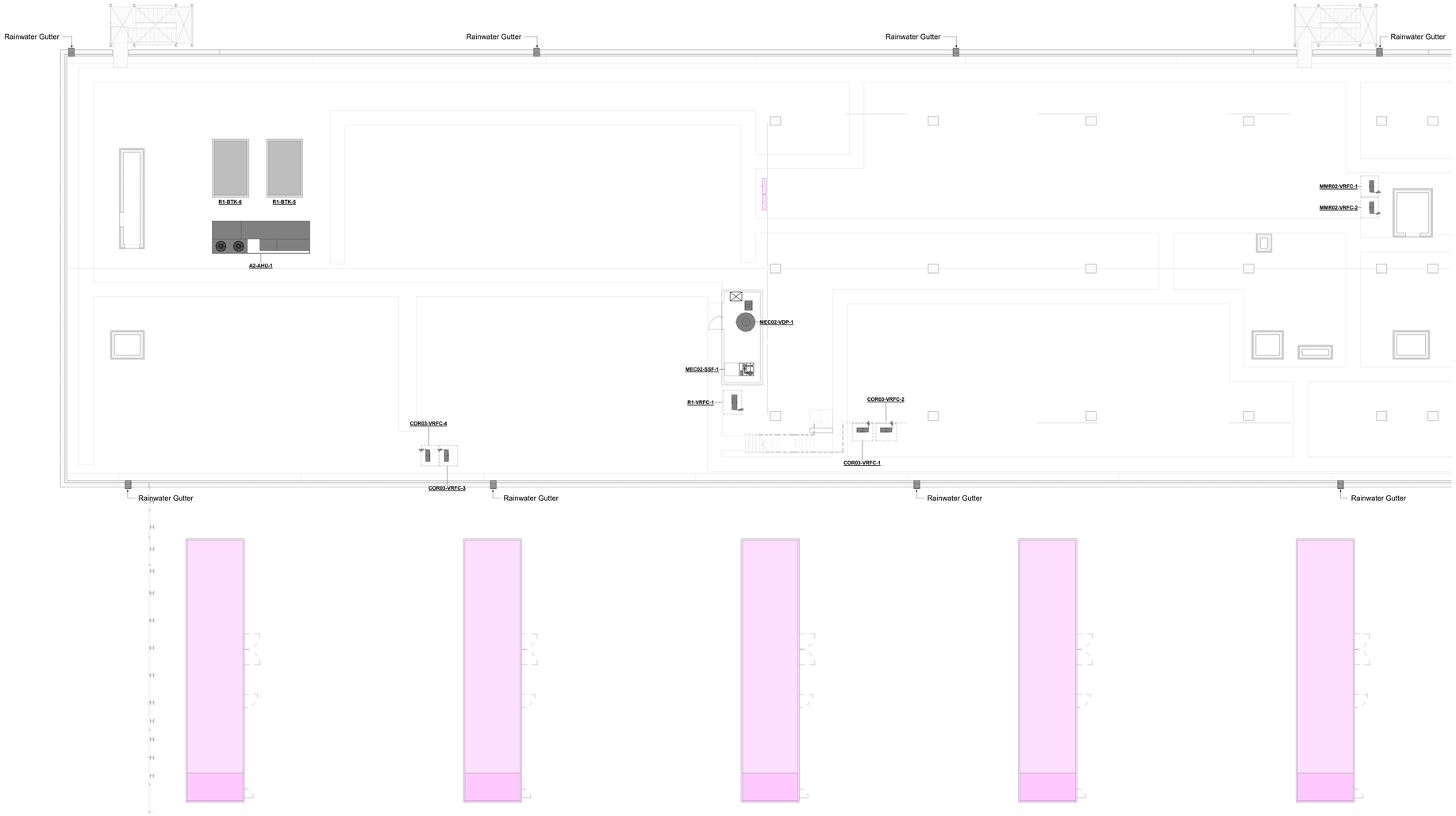
Rainwater Gutter
Rainwater Gutter
Rainwater Gutter
Rainwater Gutter
R1-BTK-6
R1-BTK-8
A2-AHU-1
MMR02-VRFC-1
MMR02-VRFC-2
MEC02-VDP-1
MEC02-SSF-1
R1-VRFC-1
COR03-VRFC-2
COR03-VRFC-4
COR03-VRFC-1
COR03-VRFC-3
Rainwater Gutter
Rainwater Gutter
Rainwater Gutter
Rainwater Gutter
H
H
H

0 2 4 6 8 10m

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto
STACK MIL07 Datacenter

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BIM Coordinator - *R. Sodano*

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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A2	RG	DR	M	50	131

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV. /	IssP. / Stat. / Issued for	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - Issued Submittal		07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Posizionamento Attrezzature Meccaniche
Piattaforma Chiller (RG) Fase 2 Critica
Subject:
Mechanical
Layout - Main Mechanical Equipments
Roof Gantry (RG) Critical phs.2

SIZE / FORMATO	A0 +1 (841*1189)
SCALE / SCALA	As indicated
DRAWN / DISEGNATO	M. Colombo
CHECKED / CONTROLLATO	G. Russo
APPROVED / APPROVATO	S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A2-RG-DR-M-50131.P01

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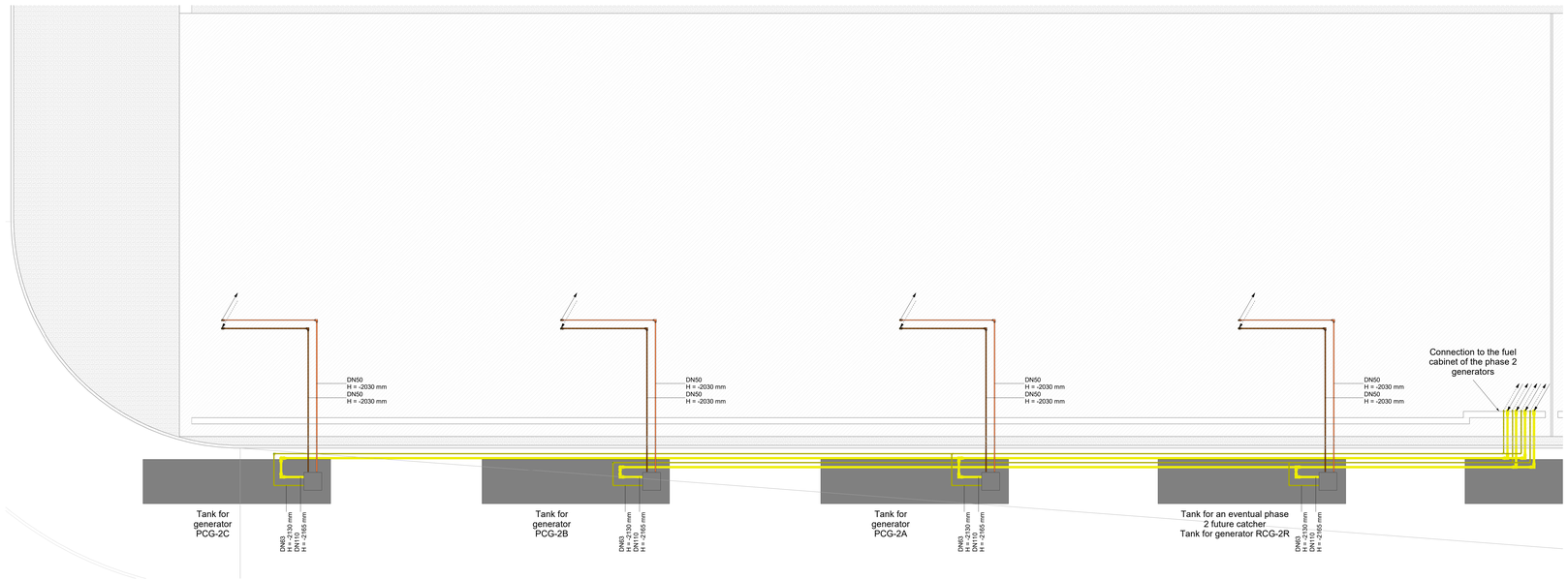

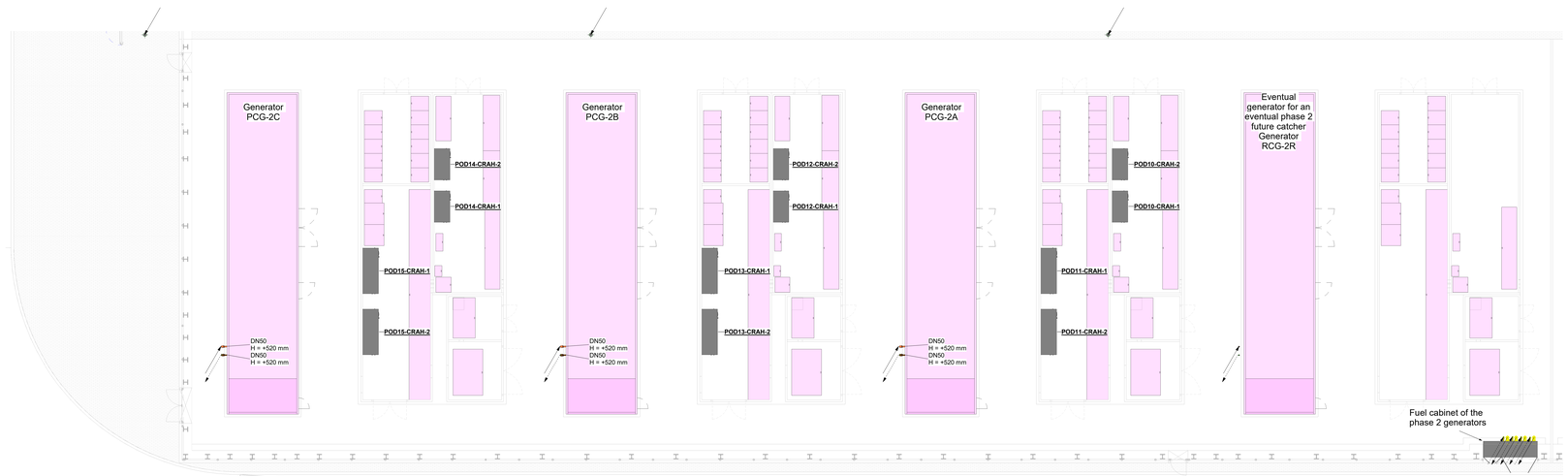

0 2 4 6 8 10m

Fuel system legend / Legenda impianto gasolio

- Diesel fuel tank supply pipe / Tubazione gasolio rifornimento serbatoio
- Diesel fuel loop-closure and ventilation pipe / Tubazione gasolio chiusura anello e ventilazione
- Generators / Gruppi elettrogeni

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
H+xxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
H+xxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Flow Direction Arrow / Frecce di Direzione del Flusso

	Supply flow / Flusso di mandata
	Supply flow to above / Flusso di mandata verso l'alto
	Supply flow to below / Flusso di mandata verso il basso
	Supply flow from below to above / Flusso di mandata dal basso verso l'alto
	Supply flow from above to below / Flusso di mandata dall'alto verso il basso
	Refrigerant gas or liquid pipe flow / Flusso tubi con gas o liquido refrigerante
	Return flow / Flusso di ripresa
	Return flow to above / Flusso di ripresa verso l'alto
	Return flow to below / Flusso di ripresa verso il basso
	Return flow from below to above / Flusso di ripresa dal basso verso l'alto
	Return flow from above to below / Flusso di ripresa dall'alto verso il basso

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STACK INFRASTRUCTURE

Project Name / Progetto
STACK MIL07 Datacenter

Location / Indirizzo progetto
Via Lombardia, 27010 Siziano PV

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BIM Coordinator - *R. Sodero*

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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	A2	ZZ	DR	M	54	501

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - BIM(2) Submittal	07/11/2025

Client / Committente
STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Pianta - Impianto Adduzione Gasolio
Piano Terra (00) e Interrato (UG) Fase 2 Critica
Subject:
Mechanical
Layout - Fuel
Ground Floor (00) and Undergound (UG) Critical phs.2

SIZE / FORMATO: A0 x1 (841*1189)
SCALE / SCALA: 1 : 100
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-A2-ZZ-DR-M-54501.P01

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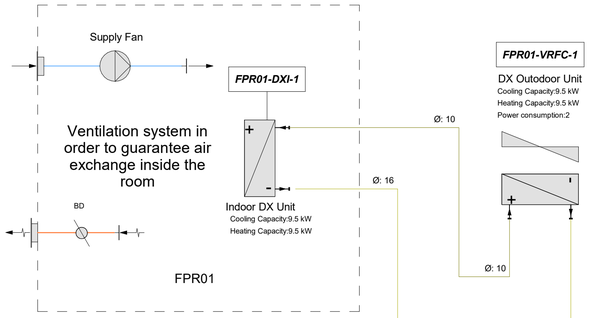

Legend

Non critical heating and cooling systems

Refrigerant Gas Pipe / Tubazione Gas Refrigerante

Refrigerant Liquid Pipe / Tubazione Liquido Refrigerante

Outdoor VRF Unit
Cooling Capacity:-
Heating Capacity:-
Power consumption:-

VRF Outdoor Unit \ Unità Esterna VRF

Outdoor VRF Unit
Cooling Capacity:-
Heating Capacity:-
Power consumption:-

DX Outdoor Unit \ Unità Esterna DX

VRF Ducted Fan Coil Unit
Cooling Capacity:-
Heating Capacity:-

VRF Ducted Fan Coil Unit / Fan Coil Canalizzabile VRF

VRF Air Curtain

VRF Air Curtain / Lama d'aria VRF

VRF Casseta 4 Way
Cooling Capacity:-
Heating Capacity:-

VRF 4 Way Cassetta / Cassetta a 4 Vie VRF

Indoor DX Unit
Cooling Capacity:-
Heating Capacity:-

Indoor DX Unit / Unità interna DX

Electrical Heater
Cooling Capacity:-
Heating Capacity:-

Electrical Radiator / Radiatore Elettrico

Electrical Air Curtain

Power consumption:2

Electrical Air Curtain / Lama d'aria Elettrica

Linee Impianto di Ventilazione / Ventilation System Lines

Presa aria esterna / Air intake

Estrazione aria / Air extraction

Simboli Impianto di Ventilazione / Ventilation System Symbols

Bocchetta Presa Aria Esterna in Facciata / External Air Intake

Facade Louvre

Bocchetta Espulsion Aria in Facciata / Facade Air Expulsion

Terminale Ripresa Aria / Air Return Grill

Terminale Mandata Aria / Air Supply Grill

Serranda di Non Ritorno / Non Return Damper

Terminale Mandata Aria / Air Supply Grill

Supply Fan

Ventilatore di Immissione / Supply fan

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CLIENT / COMMITTENTE:

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente
ARC:BIM
2nd Floor, 140 St John Street - London, GB

DESIGN TEAM / TEAM DI PROGETTO

CONSULTING DESIGNER / PROGETTISTA

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PROGETTO STRUTTURE
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PROGETTO IMP. ELETTRICI E SPECIALI
Ing. Sacha Busetti
DBA S.p.A.
Via Natale Battaglia 10, Milano (MI)

COORDINATION / COORDINAMENTO
PM - *Alessandro Masiero*
BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodano*

INTEGRATED DESIGN / PROGETTAZIONE COORDINATA:

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Sede legale: Piazza Roma, 19 32045 S. Stefano di Cadore (BL) tel. +39.0422.693511
Sede secondaria: Viale Felissent, 20/D 31020 Villorba (TV) tel. +39.0422.693511
certificata **ISO 9001:2015** RINA n.5923/01/S IQNet n.IT-19510

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	EX	RL	SD	M	55	020

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - RIBA3 Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Schematico - Impianto di Condizionamento Non Critico
Locale Pompe Antincendio Campus

Subject:
Mechanical
Schematic - Non Critical Air Conditioning System
Campus Fire Pump Room

SIZE / FORMATO: A1 [594*841]
SCALE / SCALA: NA
DRAWN / REDATTO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-EX-RL-SD-M-55020.P01

Proj. Model: MIL07_DBA
Proj. Model Version: 22-22-AM-000001

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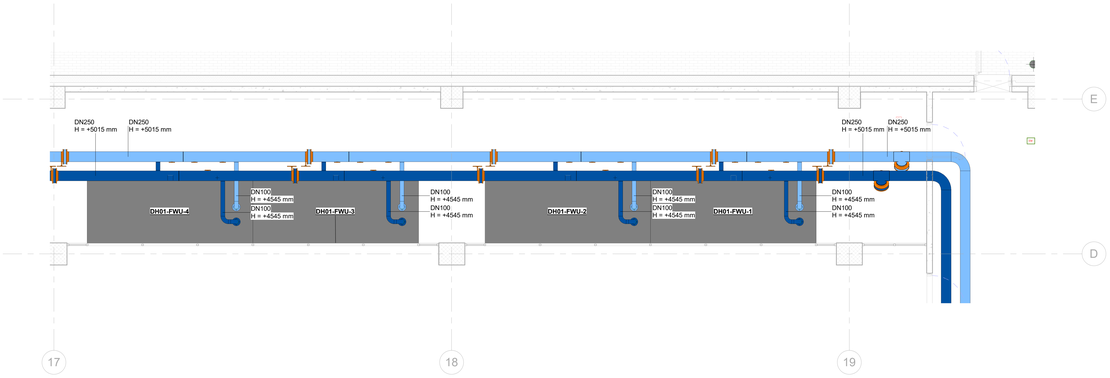
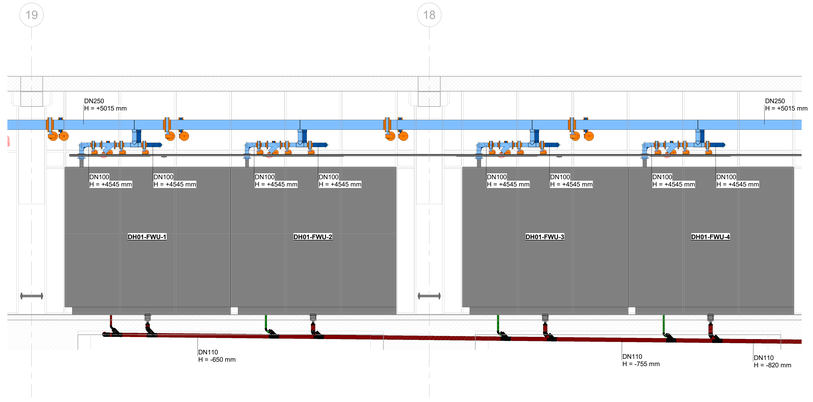


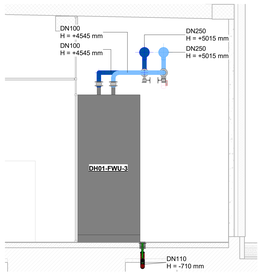
Fan Wall Gallery - Planview

1 : 50



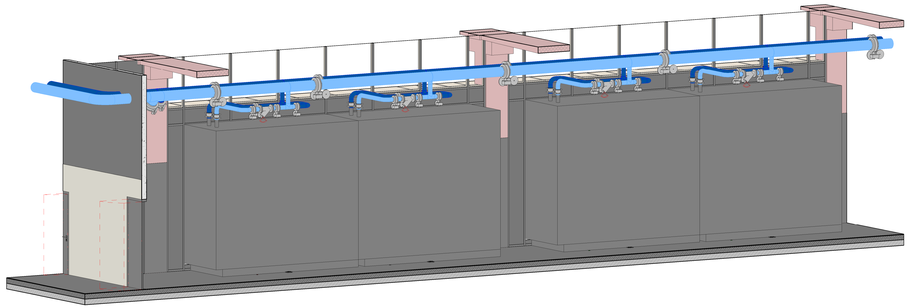
Fan Wall Gallery - Front Section View

1 : 50



Fan Wall Gallery - Side view

1 : 50



Fan Wall Gallery - 3D

0 2 4 6 8 10m

Critical cooling system legend / Legenda impianto di raffreddamento critico

- Chilled water supply / Mandata acqua refrigerata
- Chilled water return / Ritorno acqua refrigerata

Water supply and sewage system legend / Legenda impianto adduzione idrica e scarico

- Domestic Sewage / Scarico acque nere
- Process Water / Acqua di proceso
- Condense Water / Acqua di condensa
- Mechanical equipment / Attrezzature meccaniche
- Electrical equipment / Attrezzature elettriche

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
H=xxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente
ARC:BIM
2nd Floor, 140 St John Street - London, GB

DESIGN TEAM / TEAM DI PROGETTO

CONSULTING DESIGNER / PROGETTISTA

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Arch. Daniele De Bettin
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PM - *Alessandro Masiero*
BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodano*

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P.IVA 01032140255
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Cod. Fiscale 01032140255

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	ZZ	00	DR	M	50	601

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION - DESCRIZIONE REVISIONE	REVISION DATE
Client / Committente	STACK INFRASTRUCTURE	

Oggetto:
Impianti Meccanici
Dettaglio
Fan Wall Gallery
Subject:
Mechanical
Detail
Fan Wall Gallery

SIZE / FORMATO: A0 +1 (841*1189)
SCALE / SCALA: As indicated
DRAWN / REDATTO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-ZZ-00-DR-M-50001.P01

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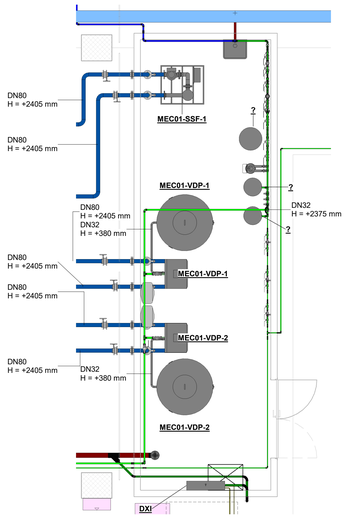
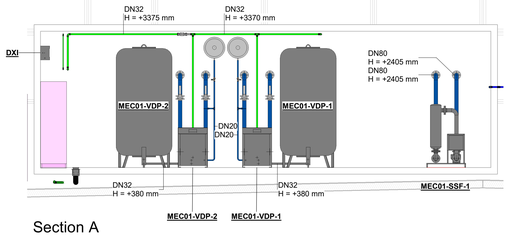


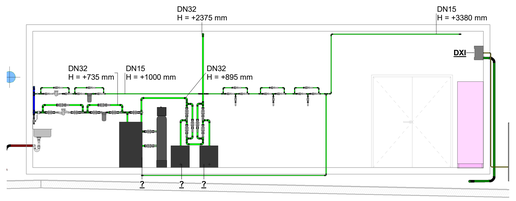
Packaged Pump Room phs 1

1 : 50



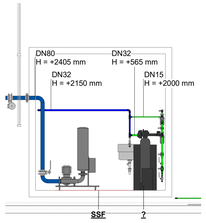
Section A

1 : 50



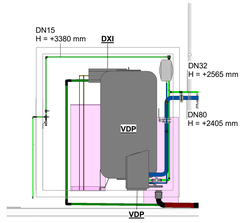
Section B

1 : 50



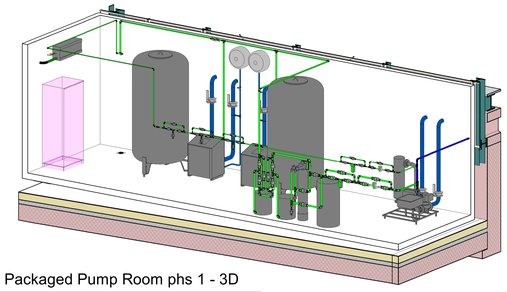
Section C

1 : 50

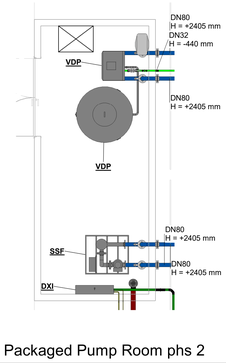


Section D

1 : 50

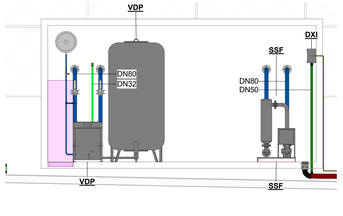


Packaged Pump Room phs 1 - 3D



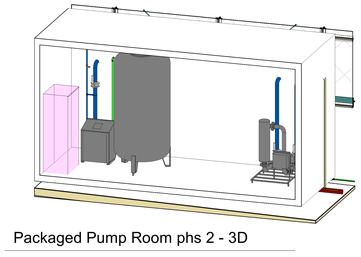
Packaged Pump Room phs 2

1 : 50



Section E

1 : 50



Packaged Pump Room phs 2 - 3D

0 1 2 3 4 5m

Critical cooling system legend / Legenda impianto di raffreddamento critico

	Chilled water supply / Mandata acqua refrigerata
	Chilled water return / Ritorno acqua refrigerata

Water supply and sewage system legend / Legenda impianto adduzione idrica e scarico

	Domestic Sewage / Scarico acque nere
	Process Water / Acqua di proceso
	Condense Water / Acqua di condensa
	Mechanical equipment / Attrezzature meccaniche
	Electrical equipment / Attrezzature elettriche

Pipe tag / Etichetta tubazioni

DNxxx ——— Diameter in millimeter / Diametro in millimetri
H=xxx mm ——— Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Progetto/Nome / Project

STACK MIL07 Datacenter

Località / Indirizzo progetto

Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente

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ARC:BIM

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Via Natale Battaglia 10, Milano (MI)

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PM - *Alessandro Masiero*
BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodano*

INTEGRATED DESIGN / PROGETTAZIONE COORDINATA

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	ZZ	R1	DR	M	50	603

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - RIBA3 Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Dettaglio
Stazione di Pompaggio Prefabbricata

Subject:
Mechanical
Detail
Packaged Pump Room

SIZE / FORMATO: A0 [841*1189]
SCALE / SCALA: As indicated
DRAWN / REDATTO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-ZZ-R1-DR-M-50603.P01

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32044 Pieve di Cadore (BL)
tel. +39.0422.650511
certificata ISO 9001:2015 RINA n.5923/01/S IQNet n.IT-19510
Sede secondaria:
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31020 Villorba (TV)
tel. +39.0422.650511

Revisione / Revision: 00
Data / Date: 2025-11-07
Stato / Status: S4-RIBA3 Submittal

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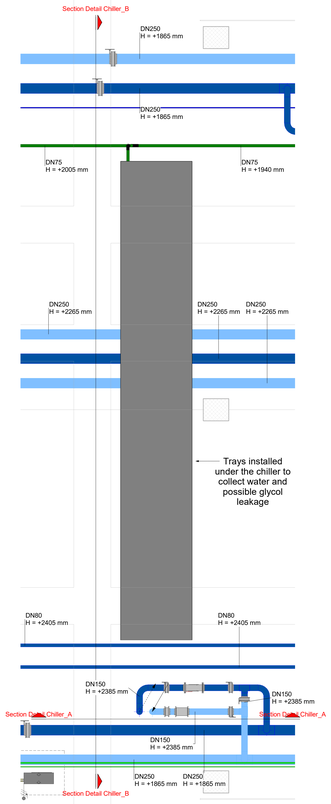
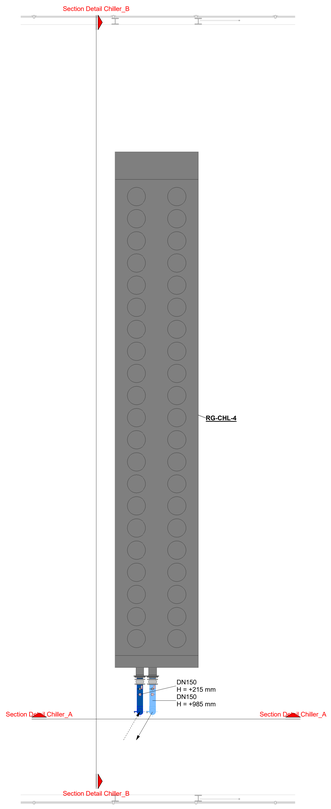


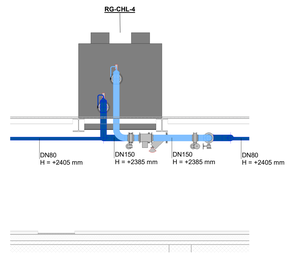
Chiller Connection Detail - Below the gantry

1 : 50



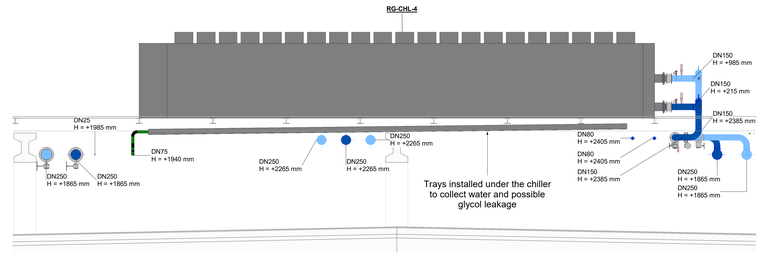
Chiller Connection Detail - Above the gantry

1 : 50



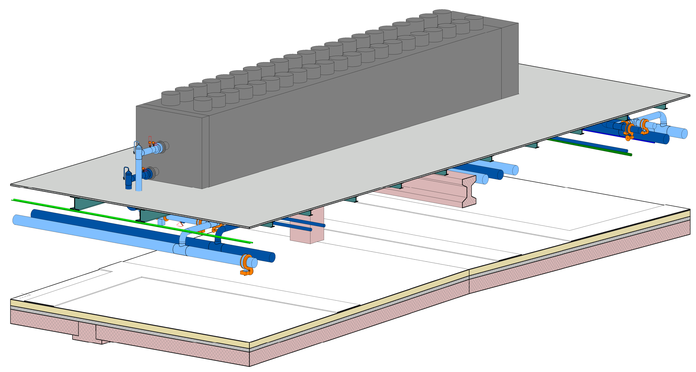
Section Detail Chiller_A

1 : 50



Section Detail Chiller_B

1 : 50



3D view Chiller Detail

Critical cooling system legend / Legenda impianto di raffreddamento critico

	Chilled water supply / Mandata acqua refrigerata
	Chilled water return / Ritorno acqua refrigerata

Water supply and sewage system legend / Legenda impianto adduzione idrica e scarico

	Cold potable water / Acqua fredda sanitaria
	Domestic Sewage / Scarico acque nere
	Process Water / Acqua di proceso
	Condense Water / Acqua di condensa
	Mechanical equipment / Attrezzature meccaniche
	Electrical equipment / Attrezzature elettriche

Pipe tag / Etichetta tubazioni

DNxxx	Diameter in millimeter / Diametro in millimetri
H=xxx mm	Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Flow Direction Arrow / Frecce di Direzione del Flusso

	Supply flow / Flusso di mandata
	Supply flow to above / Flusso di mandata verso l'alto
	Supply flow to below / Flusso di mandata verso il basso
	Supply flow from below to above / Flusso di mandata dal basso verso l'alto
	Supply flow from above to below / Flusso di mandata dall'alto verso il basso
	Refrigerant gas or liquid pipe flow / Flusso tubi con gas o liquido refrigerante
	Return flow / Flusso di ripresa
	Return flow to above / Flusso di ripresa verso l'alto
	Return flow to below / Flusso di ripresa verso il basso
	Return flow from below to above / Flusso di ripresa dal basso verso l'alto
	Return flow from above to below / Flusso di ripresa dall'alto verso il basso

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CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto
STACK MIL07 Datacenter

Location / Indirizzo progetto
Via Lombardia, 27010 Siziano PV

BIM Client Consultant / Consulente BIM del Cliente
ARC:BIM
2nd Floor, 140 St John Street - London, GB

ARC:BIM

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BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodano*

INTEGRATED DESIGN / PROGETTAZIONE COORDINATA:

DBA

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Piazza Roma, 19
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certificata ISO 9001:2015 RINA - n.08239.VS Ghana s.r.l.
Sede secondaria:
Viale Felissent, 20D
31020 Villorba (TV) Italia
tel. +39.0422.303411

PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	ZZ	RG	DR	M	50	602

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION - DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - RIBAS Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

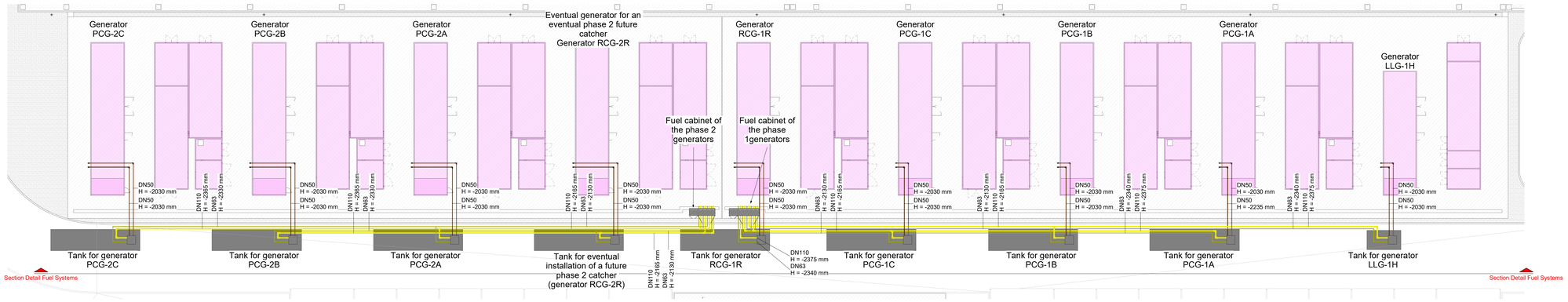
Oggetto:
Impianti Meccanici
Dettaglio
Piattaforma Chiller

Subject:
Mechanical
Detail
Chiller Platform

SIZE / FORMATO	A0 +1 (841*1189)
SCALE / SCALA	As indicated
DRAWN / DISEGNATO	M. Colombo
CHECKED / CONTROLLATO	G. Russo
APPROVED / APPROVATO	S. Busetti

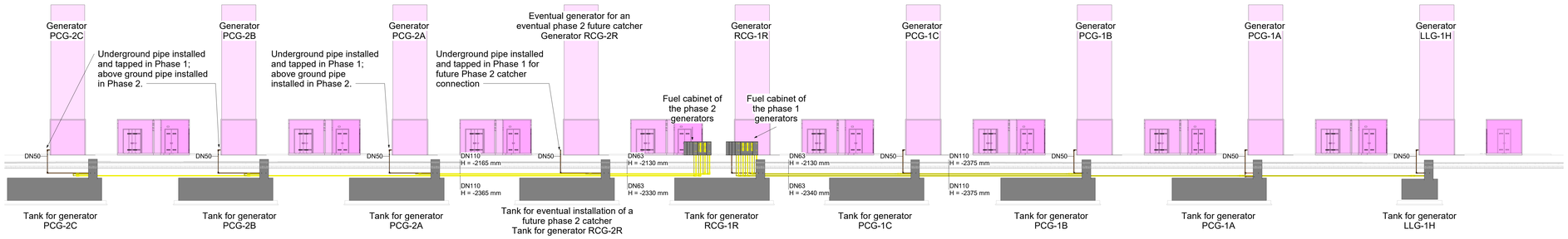
FILE NAME / NOME FILE: MIL07-DBA-ZZ-RG-DR-M-50602.P01

PROPERTY OF DBA S.p.A. NON UTILIZZABILE O REPLICABILE (ANCHE IN PARTE) SENZA CONSENSO SCRITTO DA PARTE DI DBA.



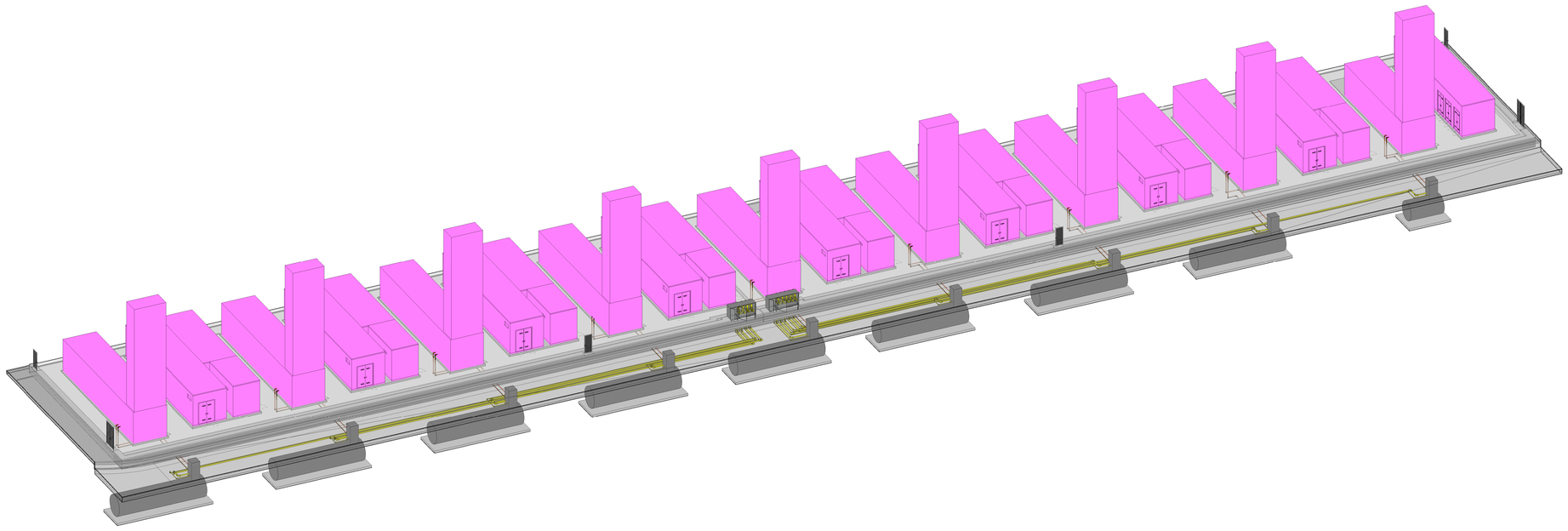
Fuel System Planview

1 : 200



Fuel System Section View

1 : 200



3D Detail Fuel

N

0 4 8 12 16 20m

Fuel system legend / Legenda impianto gasolio

	Diesel fuel tank supply pipe / Tubazione gasolio rifornimento serbatoio
	Diesel fuel loop-closure and ventilation pipe / Tubazione gasolio chiusura anello e ventilazione
	Generators / Gruppi elettrogeni

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
H=xxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Pipe tag / Etichetta tubazioni

DNxxx — Diameter in millimeter / Diametro in millimetri
H=xxx mm — Bottom of pipe in millimeter / Quota inferiore tubazione in millimetri

Flow Direction Arrow / Frecce di Direzione del Flusso

	Supply flow / Flusso di mandata
	Supply flow to above / Flusso di mandata verso l'alto
	Supply flow to below / Flusso di mandata verso il basso
	Supply flow from below to above / Flusso di mandata dal basso verso l'alto
	Supply flow from above to below / Flusso di mandata dall'alto verso il basso
	Refrigerant gas or liquid pipe flow / Flusso tubi con gas o liquido refrigerante
	Return flow / Flusso di ripresa
	Return flow to above / Flusso di ripresa verso l'alto
	Return flow to below / Flusso di ripresa verso il basso
	Return flow from below to above / Flusso di ripresa dal basso verso l'alto
	Return flow from above to below / Flusso di ripresa dall'alto verso il basso

Il presente elaborato è valido solo in coordinamento con tutte le altre discipline specialistiche con le quali deve essere verificata la conformità. Tutte le misure ed eventuali variazioni rispetto al presente elaborato devono essere verificate in cantiere.
This plan only valid in connection & coordination with the plans of all other Specialist disciplines, and must be checked for conformity with these plans. Deviations in dimensions must be clarified with the site management.

CLIENT / COMMITTENTE:

STACK INFRASTRUCTURE

Project Name / Progetto:
STACK MIL07 Datacenter

Location / Indirizzo progetto:
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ARC:BIM

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CONSULTING DESIGNER / PROGETTISTA

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DBA S.p.A.
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BIM Manager - *S. Di Biase*
BIM Coordinator - *R. Sodeno*

INTEGRATED DESIGN / PROGETTAZIONE COORDINATA:

DBA

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PROJECT CODE	ORIGINATOR	FUNCTIONAL	SPATIAL B.	FORM	DISCIPLINE	TYPE	NUMBER
MIL07	DBA	ZZ	ZZ	DR	M	50	600

NOTES / NOTE:

DBA PROJECT CODE	PROJECT STAGE	STATUS / STATO	REVISION / REVISIONE	DATE / DATA
13038001	WS3	S4	P01	07/11/2025

REV.	REVISION DESCRIPTION / DESCRIZIONE REVISIONE	REVISION DATE
P01	S4 - RIBA3 Submittal	07/11/2025

Client / Committente: STACK INFRASTRUCTURE

Oggetto:
Impianti Meccanici
Dettaglio
Impianto a Gasolio

Subject:
Mechanical
Detail
Fuel Installation

SIZE / FORMATO: A0 [841*1189]
SCALE / SCALA: As indicated
DRAWN / DISEGNATO: M. Colombo
CHECKED / CONTROLLATO: G. Russo
APPROVED / APPROVATO: S. Busetti

FILE NAME / NOME FILE: MIL07-DBA-ZZ-ZZ-DR-M-50600.P01

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